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EXTILE
EMISTRY
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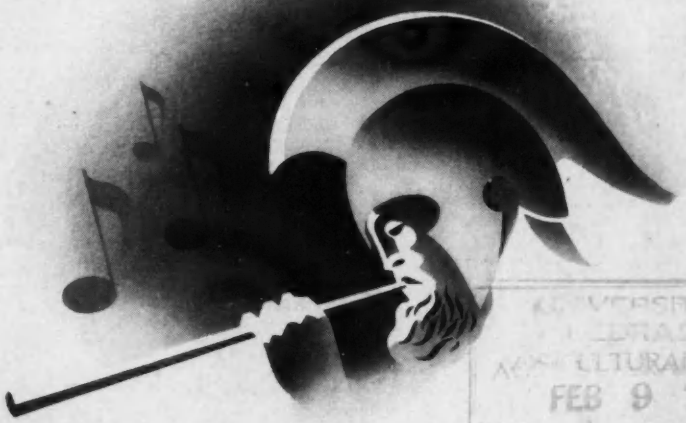
ARY 31, 1944
ME 33, No. 3

AMERICAN

DYESTUFF REPORTER

AL PUBLICATION
of the
ROCEEDINGS
AN ASSOCIATION
XTILE CHEMISTS
D COLORISTS

MARS PIPES THE TUNE



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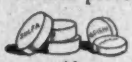

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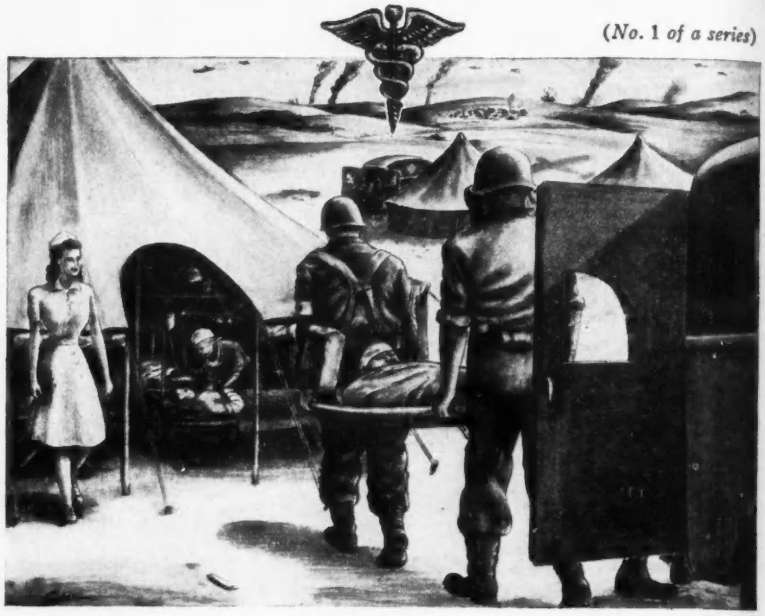

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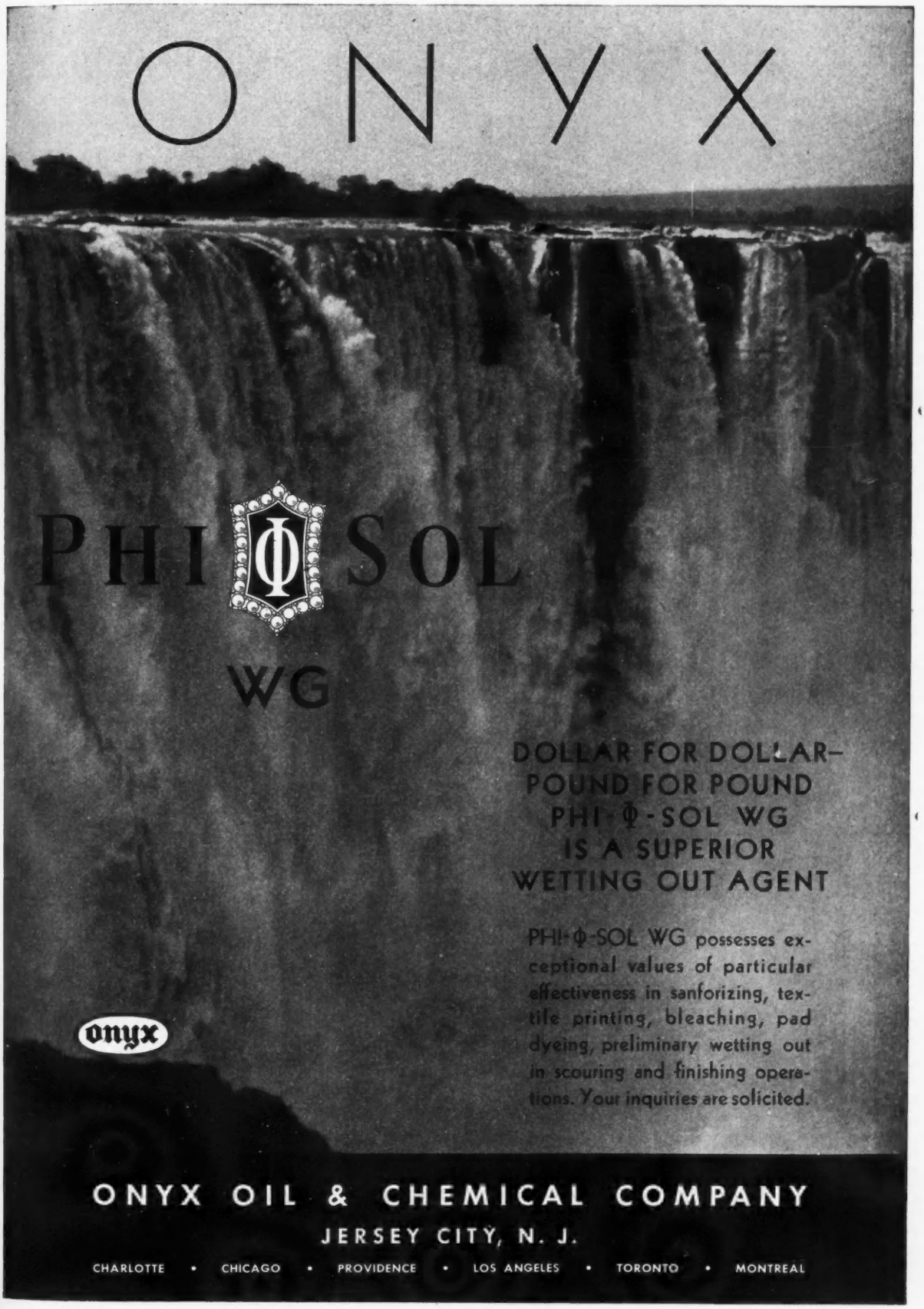
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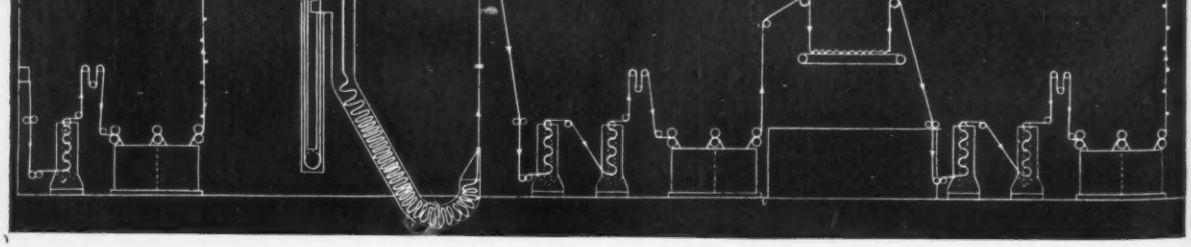
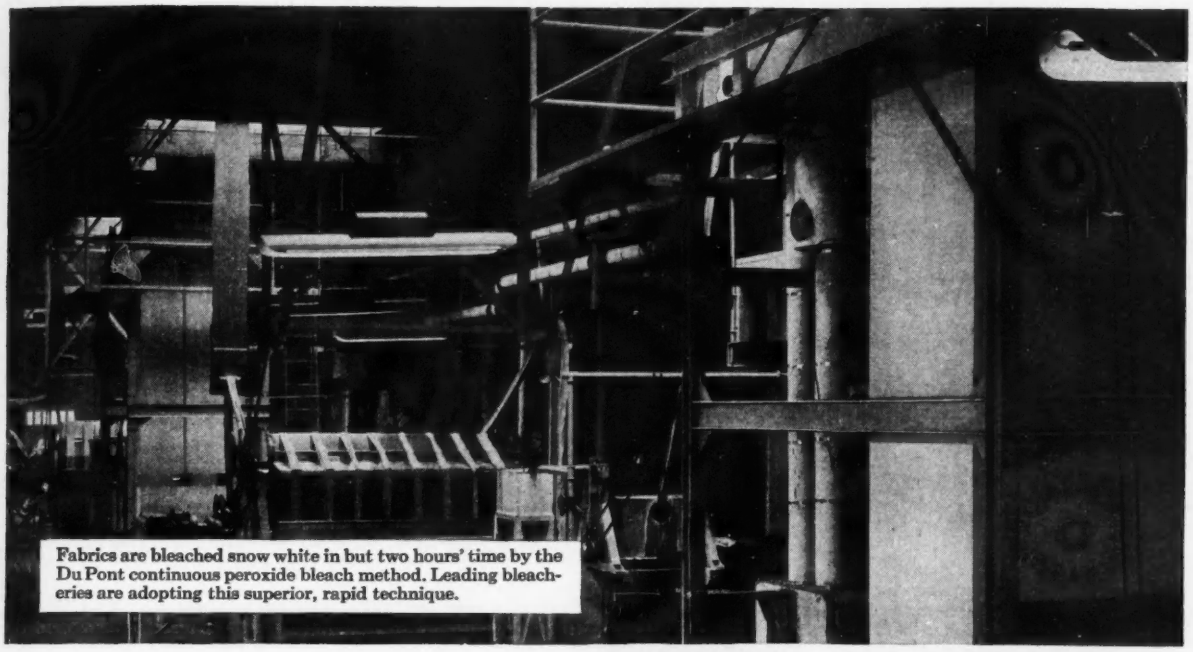


PEROXIDE BLEACH



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This photograph shows a unit in the Du Pont continuous bleach process where the fabric is rapidly saturated with dilute hydrogen peroxide.

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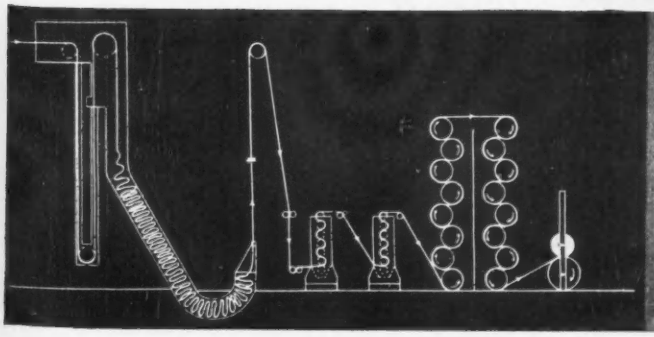

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JANUARY 31, 1944

VOLUME 33 NUMBER 3

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Contents

Contents of previous issues can be found by consulting the Industrial Arts Index at your library

• Departments

Trade Notes—New Products..... 71

• Proceedings of the American Association of Textile Chemists and Colorists

Microscopical Observations of Wool Dyeing Part IV—Quantitative Study of Effect of Time and Temperature P52

Willard H. Watkins, George L. Royer and Henry E. Millson

Future Meetings, Philadelphia Section..... P68

Membership Applications P68

Meeting, Rhode Island Section..... P69

Piedmont Section Plans..... P69

Meeting, Philadelphia Section..... P69

Calendar of Coming Events..... P70

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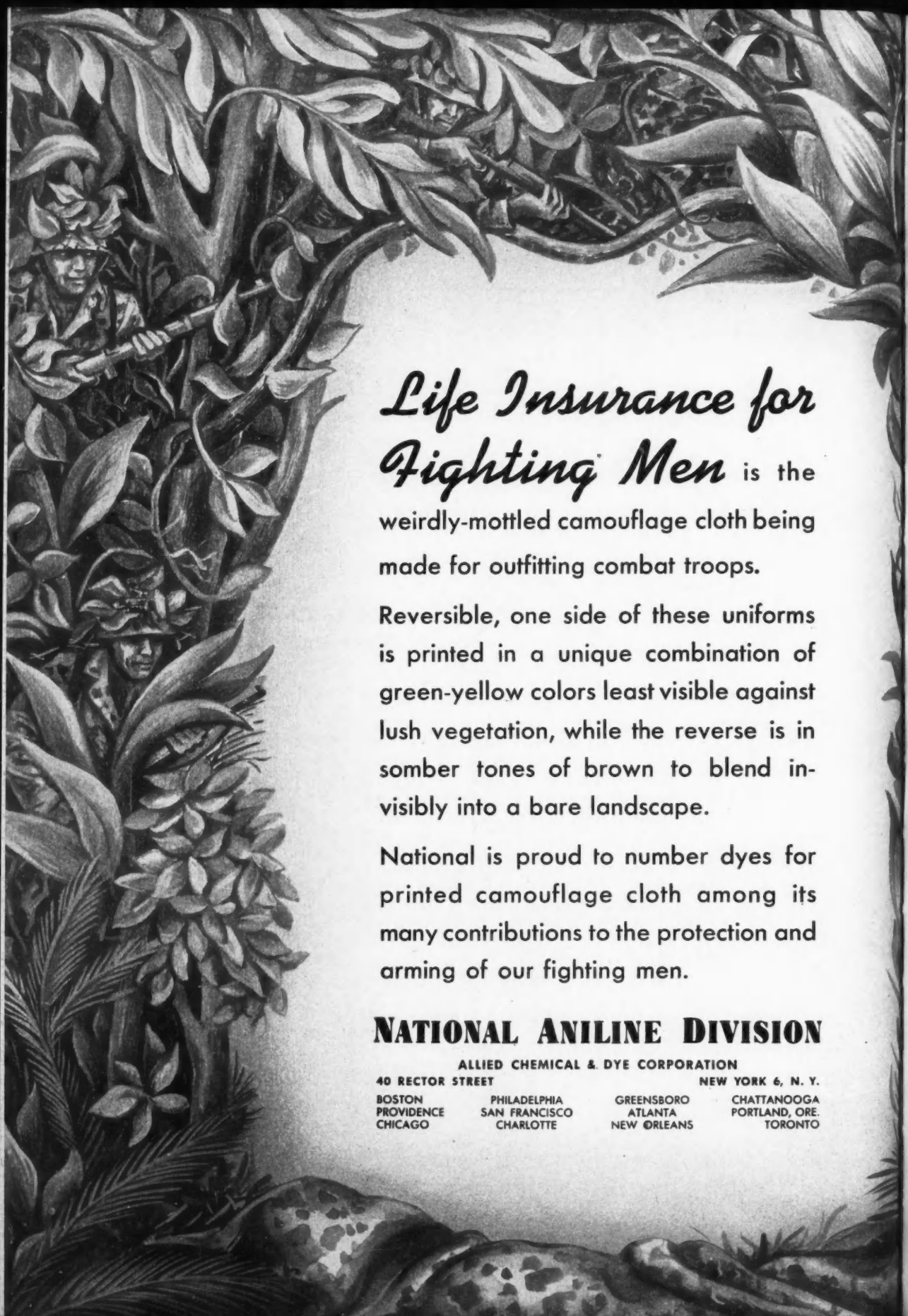

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JANUARY 31, 1944

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MICROSCOPICAL OBSERVATIONS OF WOOL DYEING*

Part IV–Quantitative Study of Effect of Time and Temperature

WILLARD H. WATKINS, GEORGE L. ROYER and HENRY E. MILLSON

Calco Chemical Division, American Cyanamid Company

IN three previous papers [1, 2, 3] fiber levelness or fiber selectivity has been discussed from the viewpoint of both its cause and its effect upon the color strength, the shade, and the fastness of the dyed goods. During the dyeing, changes in the rate of exhaustion and color build-up take place and it has seemed worthwhile to investigate these changes by microscopical procedures. The effect of time and temperature on the absorption and diffusion of the dye into the individual fibers has been studied to determine the cause for the changes encountered during practical dyeing operations.

In dyestuff application, the equal distribution of the color over the fabric is known as levelness. When a dye distributes itself evenly over all of the goods and can cover up portions which may have been undyed or lightly dyed in the early stages, the dyestuff is a level dyeing color. If a dye does not give even color value or shade from one portion of the fabric to another, except under carefully controlled conditions, the dye is a poor leveling color since it may produce an unlevel result. These poor leveling types of dyes are important because they generally have some superior fastness properties. We have called this type of leveling, material leveling; including in the term "material" not only pieces but skeins, packages, slubbing and stock.

Another type of leveling which has developed from microscopical studies is called fiber levleness. When the distribution of dye from fiber to fiber is the same, the material has good fiber levelness. Fiber unlevelness is an unevenness in dye distribution which exists from fiber to fiber. The cause may be the result of fundamental differences in the fibers themselves which control the exhaustion and diffusion of the dye into the individual fibers or differences in the actual dye molecule. Fiber unlevelness shows as skitteriness, poor fastness properties, low color value or as a lack of solidity of shade in fabrics which may otherwise be material level.

Dyeings can be made which will have good material levelness but still have poor fiber levelness. Often poor fiber levelness is indicative of poor material levelness and modifications in the methods of application should be made to produce good fiber levelness so that the best possible results are obtained. When discussing leveling, two mechanisms must be considered. One in which the dye goes onto the fibers slowly and uniformly, staying where it is first exhausted, and the other where the dye moves back and forth between the dye bath and wool and thus redistributes itself evenly throughout all of the fibers. With colors which dye by this latter mechanism, leveling is not a problem when sufficient time can be allowed for this process because, if run long enough, level fiber and material dyeing will be obtained. In the case of colors which dye by the first mechanism, it is necessary to use care in their application. Proper mechanical movement of the dye solution through the material or the material through the dye bath and the control of the rate at which the dye is exhausted are important so that the best dyeings can be obtained in the least time.

One very important factor influencing the removal of dye from the dye bath is temperature. This has been emphasized by the work published by Goodall and Hobday.[7, 8] The studies carried out in this paper have shown both practically and microscopically that there are certain temperatures in the dyeing of wool at which rapid changes in the rate of adsorption and penetration of the dye take place. These have been defined as critical temperatures or points. It is important that the dyeing at or near these temperatures be carefully controlled so that the best material levelness will be obtained. The microscopical studies show what actually takes place in the individual fibers and these are discussed relative to the practical results.

PRACTICAL DYEING EXPERIMENTS

It is a well-known fact that pieces or skeins dyed in machines of large capacity will show shades of unequal depth if during the dyeing operation the temperature varies from one side of the machine to the other. Temperature studies of practical dyehouse runs have shown definitely that a difference of even five degrees Fahrenheit from side to side will at certain temperatures cause the wool to dye noticeably lighter or darker.

In actual plant experiments, several five-hundred-pound lots of worsted skeins were dyed an olive drab with chrome dyes in a rotary type machine; samples were removed and the temperature recorded every five minutes. The

* Presented at meeting, Northern New England Section, October 15, 1943.

most noticeable variations in shade occurred at two stages of the dyeing process; the first, between 135° F. and 150° F., and the second, between 165° F. and 190° F. These experiments indicated that two critical temperature points were reached when dyeings of this color formulation were started at 100° F. and raised gradually to the boil. Critical points were found to vary with different dyes and were influenced by radical changes in dyeing methods. When the temperature of one side of the machine was 100° F., and the temperature of the other side was 110° F., no significant difference in shade was seen. However, a difference of ten degrees for only ten minutes between 180° and 190° F., caused the hotter side to become darker. Boiling for one hour failed to equalize the shade and no further leveling was obtained during the top chroming operation.

Sulfon cyanines were found, many times, to give unlevel or uneven results when applied to the same lot of goods and in the same machine without any apparent difference in dyeing procedure. The operators had been instructed to bring the lot to a boil within one hour and boil 30 minutes before sampling. However, at times the steam pressure varied; and when the operators found that the amount of steam flowing into the kettle was insufficient to raise the lot to the boil within the prescribed time, they would open the steam valve wider in order to arrive at the boil within the time limit. This changing of the steam usually took place between 170° F. and 190° F., which we now know is within one critical temperature range for sulfon cyanines (see Fig. 1). When lots were brought to the boil by setting the steam valve at the start and not changing it until the boil was reached, uneven lots became a rarity. When critical points are reached in the course of dyeing at the same time that the operator is increasing the amount of steam, the rapid rise in temperature speeds up the exhaustion of the dye and the color is deposited rapidly on the outer exposed parts of skeins or pieces and unevenness results. These heavier depositions cause permanent defects because sulfon cyanines do not level well and very little redistribution of the dye takes place under normal dyeing conditions.

Acid dyes with good leveling properties tend to overcome shade differences during boiling, but that is not true of most milling and some chrome dyes. When these poor leveling colors are absorbed by wool, their ability to equalize and level is greatly reduced. This is also true of meta chrome dyes to an even greater extent because the presence of chrome causes most of the dye to be converted to the insoluble chromium complex. Therefore, very little, if any, movement of the dye from fiber to fiber is obtained.

MICROSCOPICAL COUNT PROCEDURE

Microscopical examination of dyeings in thin cross sections prepared by the usual histological procedure or by the quicker, easier method described by Hardy [4] reveals differences in the dyeing of the individual fibers in many cases. Each of the previous papers showed photomicrographs of wool cross sections which exhibited various degrees of fiber levelness. It was difficult to classify these in other than general groups such as "excellent," "good," "fair," or "poor" by an over-all visual examination. However, the method used in this paper, the counting of the various types of fibers such as (1) undyed, (2) ring dyed, (3) light dyed and (4) dark dyed makes it possible to determine the percentage of each present in a sample.

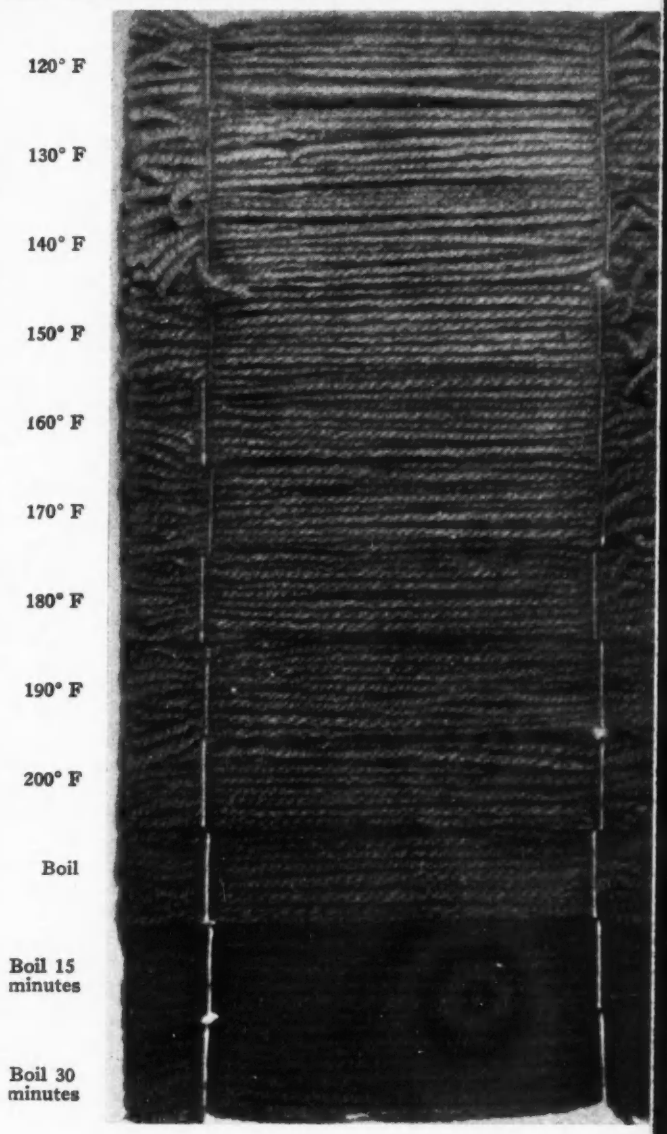


Fig. 1

The cross sections used in the preparation of this paper were again made by Hardy technique.* The number of

* The authors wish to express their appreciation to Mrs. Anne M. Harding, who made the fiber counts.

undyed, ring dyed and completely dyed fibers was counted in several fields of the same sample so that a representative average was obtained. It was believed that a total fiber count of 200 to 250 was sufficient when the other variables of the dyeing procedure were taken into consideration. The count can be made by a direct visual examination through the microscope, or, as we have found, it can be obtained more easily by a projection counting method. The slide was projected by a microscope in a dark room onto a piece of white paper which served as a screen (Fig. 2). As the fibers were counted, identifying marks were made on the image of each fiber on the paper and the individual count recorded by the use of four automatic counters. By this method, all of the fibers in the field were marked as they were counted so that each was recorded but once. The actual counts were then converted to a percentage basis and listed in a table. Table I shows the counts obtained and the converted percentages for Calcochrome Violet B, Colour Index No. 169.

DYEING PROCEDURE

The method just described can be used to study the fiber levelness of any dyeing, and in this investigation it was used to correlate the temperature and time of dyeing with the fiber levelness. Therefore, the percentages of the various types of fibers in each specified sample removed during the dyeing operation were plotted against the time and temperature. These curves show visually the fiber levelness for each dye at different periods during the dyeing operation. For example, Graph 9 shows the plotted curves for the data given in Table I which were obtained from the Calcochrome Violet B dyeing experiment.

The skein dyeings were made in the laboratory under carefully controlled conditions. The heating was carried out on a water bath regulated to increase the temperature ten degrees Fahrenheit every three minutes. Several threads were removed at random from the skein at three minute intervals, rinsed carefully, and dried. Only small pieces of the threads were removed each time so as not to disturb the wool-to-dye bath ratio.

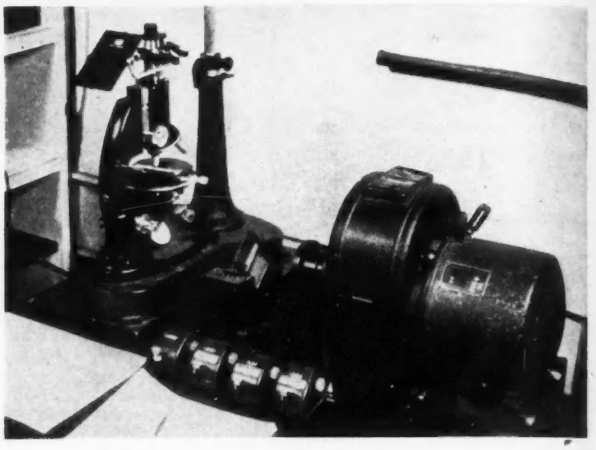


Fig. 2

The accuracy of the dyeing and counting methods was checked by repeating the dyeings of Calcochrome Fast Red ECB on regular yarn—two years apart. The critical points during the course of dyeing were found to be the same; the fiber count percentages showed a variation of less than 5%. Samples removed from several practical dyeings indicated that the critical points are approximately those found in the laboratory-controlled experiments.

The procedures and assistants used for the dyeings were as follows:

Acid Colors—2% Dyeings.	Bath Ratio 60-1
Calcocid Phloxine 2G	Colour Index 31
Calcocid Alizarine Blue SKY	Colour Index 1088
Calcocid Alizarine Blue SAPG	Colour Index 1054
Calcocid Blue VS	Colour Index 712
10% Calcined Glauber's Salt	
4% Sulfuric Acid	

TABLE I

Count Data on Calcochrome Violet B

	Dark	*%*	*Light*	*%*	*Ring*	*%*	*Undyed*	*%*	*Total*	
100° F.			(0)	0	(54)	28	(139)	72	(193)	100
110° F.			(4)	2	(200)	98	(0)	0	(204)	100
120° F.			(0)	0	(200)	100			(200)	100
130° F.	(0)	0	(0)	0	(200)	100			(200)	100
140° F.	(1)	1	(2)	1	(177)	98			(180)	100
150° F.	(2)	1	(4)	2	(163)	97			(169)	100
160° F.	(39)	21	(150)	79	(0)	0			(189)	100
170° F.	(40)	21	(151)	79					(191)	100
180° F.	(44)	25	(133)	75					(177)	100
190° F.	(61)	32	(132)	68					(193)	100
200° F.	(62)	32	(132)	68					(194)	100
212° F.	(67)	32	(144)	68					(211)	100
Boil 3 Mins.	(59)	29	(142)	71					(201)	100
Boil 6 Mins.	(0)	0		100					(200)	100
Boil 9 Mins.				100					(200)	100
Boil 12 Mins.				100					(200)	100
Boil 15 Mins.				100					(200)	100

( ) Actual Count. % Per cent Count.

Milling Colors—2% Dyeings. Bath Ratio 60-1

Calcocid Milling Orange 4R
Calcocid Milling Red RC Conc. Colour Index 430
Calcocid Milling Red 3B Colour Index 487
Calcocid Milling Red 3R Conc. Colour Index 275
10% Calcined Glauber's Salt
3% Acetic Acid 56%

Chrome Colors—2% Dyeings. Top Chrome. Bath Ratio 60-1

Top chrome method without afterchrome. All references to top chrome dyeing in this paper are carried out as top chrome dyeings and stopped at the point where the chrome would be added.

Calcochrome Fast Green SGV Colour Index 292
Calcochrome Fast Red ECB Colour Index 652
Calcochrome Alizarine Blue Black B Colour Index 1085
Calcochrome Violet B Colour Index 169
Calcochrome Alizarine Red SC Colour Index 1034
Calcochrome Black PV Colour Index 170
Calcochrome Green SW
Calcochrome Brown PG
10% Calcined Glauber's Salt
2% Acetic Acid 56%

Chrome Colors—2% Dyeings. Meta Chrome. Bath Ratio 60-1

Calcochrome Alizarine Blue Black B Colour Index 1085
Calcochrome Brown EB Colour Index Pr. 14
Calcochrome Brown RH Colour Index 98
8% Ammonium Sulfate
1% Potassium Bichromate
2% Acetic Acid 28%

Calcofast Colors—3% Dyeings. Bath Ratio 60-1

Calcofast Wool Blue 2B (metallized dye)
Calcofast Wool Orange 4RN (metallized dye)
8% Sulfuric Acid

DISCUSSION OF DATA*

Acid Colors

A number of typical acid dyestuffs were chosen to study the relationship between temperature and dyeing properties. The dyeing and microscopical procedures described previously were used. The data for Calcocid Blue VS, a typical level dyeing color, are shown in Graph 1. It can be seen that the build-up to the highest per cent of ring dyed fibers is slow and the maximum of 80% is not reached until about 180° F. (Fig. 3). At this point, the diffusion of the dye into the fiber increases the number of completely dyed fibers. After boiling twelve minutes, the fibers are all dyed about the same shade (Fig. 4). The relatively slow rate of exhaustion of this color along with the quick development of completely dyed fibers makes this a very level dyeing color. Calcocid Phloxine 2G (Graph 2), Calcocid Alizarine Blue SAPG (Graph 3), and Calcocid Alizarine Blue SKY (Graph 4) are other examples of level dyeing acid colors similar to Calcocid Blue VS but somewhat less level dyeing. The graphs of these three colors show a difference from that of Calcocid Blue VS in that dark dyed fibers appear during the stage immediately after the maximum ring dyeing is obtained. These dark dyed fibers increase in number until the boil is reached. Thereafter, they begin to lose this excess of color, and on boiling a short time, all fibers are a uniform depth of shade.

Most milling colors, in regard to levelness, are inferior to the acid colors just described. For example, in Calcocid Milling Orange 4R (Graph 5), the maximum number of ring dyed fibers is not reached until 200° F. (See Fig. 5). At this point both light and dark dyed fibers begin to appear and boiling for 30 minutes does not redistribute the absorbed dye or give uniform fiber levelness (see Fig. 6).

The individuality of each dye within similar classes is emphasized by a study of three other milling colors. Calcocid Milling Red 3R Conc. (Graph 6) shows 69% of the fibers undyed and 31% ring dyed at 100° F., within 3 minutes, and a rise of temperature to 110° F., 100% of the fibers are ring dyed. The second point is reached between 190° F. and 200° F., when 94% are ring dyed at 190° F. and change to 80% completely dyed when 200° F. is reached. On the other hand, Calcocid Milling Red 3B (Graph 7) is not 100% ring dyed until 150° F. Even after 15 minutes' boiling, only 15% of the ring dyed fibers become completely penetrated. In combination with other milling colors, the Red 3B often produces skittery effects. The Calcocid Milling Red RC Conc. dyeing (Graph 8) has 88% undyed and 12% ring dyed fibers at 160° F., but a marked change takes place between 160° F. and 170° F. to give 94% ring dyed and only 6% undyed. After boiling 9 minutes 70% of the fibers are still ring dyed, 25% are completely dyed, and 5% are darkly dyed. Boiling 15 minutes shows 92% completely dyed and 4% darkly dyed. The leveling properties are probably related to the ease with which diffusion of the dye into the fiber takes place once the dye is on the fiber. Calcocid Milling Reds RC Conc. and 3B are rated 1 as to level dyeing and do not diffuse into the fibers completely during normal dyeing time unless high temperatures are maintained, whereas Calcocid Milling Red 3R Conc. rates 2-3 to level dyeing and by the time 200° F. is reached, 80% of the fibers are completely dyed.

In general, poor leveling dyes continue to build up in depth of color with very little equalization of the absorbed dye taking place. Some fibers may remain undyed throughout the dyeing operation, while other fibers which are heavily dyed continue to increase in color content without releasing their dye to these undyed fibers. Thus a cross-sectional pattern for the finished dyeing will show dark, light and undyed fibers. We refer to this as poor fiber

*The original presentation of this paper was illustrated with Kodachrome Color Photomicrographs. For this publication, it has been necessary to make the reproductions in black and white. It has been somewhat difficult to represent the actual observations in this matter and, in many cases, only direct microscopical examination under different illumination conditions reveals the differences described. This is particularly true of the microscopical counts of the ring-dyed fibers which, in many cases, are lightly dyed and difficult to recognize.

levelness. In contrast, the cross sections of a dyeing produced with a dye which levels well will, in the early stages, show different degrees of dye penetration, but the dye can be removed from the dark fibers and absorbed by the light or undyed fibers to give a final dyeing in which all of the fibers are dyed equally. We refer to this as good fiber levelness.

When using level dyeing colors, it is not necessary to be so careful in the handling of the goods at the critical points since any unevenness in dye absorption is generally corrected by a redistribution of the color during boiling. In the case of poor leveling dyes, it should be emphasized that the exhaustion and distribution of dyes must be carefully controlled by proper movement of the pieces or skeins in the dye bath or by the proper flow of dye liquor through the wool when the times at which the critical temperatures are reached. Otherwise, any dye deposited unevenly on the outside portions of the material being dyed will not be redistributed either during the normal dyeing process or when redyed without the use of drastic corrective measures.

Top Chrome Dyeing (Without Afterchrome)

Calcochrome Violet B (Graph 9) is an excellent example of a level dyeing color and rates 4-5. At 100° F., 72% of the fibers are undyed and 28% are ring dyed. At 110° F., 98% are ring dyed. Between 150° F. and 160° F. it changes from 97% ring dyed to 79% lightly dyed and 21% darkly dyed. Violet B also exhibits another phenomenon not found to the same extent in any other chrome or milling dye studied; and that is, a further leveling between light and dark dyed fibers. The fiber counts show that leveling continues until an equilibrium is reached at which time all fibers contain the same amount of dye regardless of their condition. Some dyes accentuate this difference between fibers giving a skittery appearance, while others tend to overcome or cover up these inequalities.

Calcochrome Alizarine Red SC (Graph 10) rates 4-5 to level dyeing and though it acts differently from Violet B, in the early stages of dyeing, both reach 100% dyed fibers between 150° F. and 160° F. After boiling for a few minutes, all fibers have leveled out and, therefore, the Red SC will be level when afterchromed. Calcochrome Black PV (Graph 11) changes from 62% undyed and 37% ring dyed at 130° F. to 94% ring dyed and 6% completely dyed at 140° F. Another critical point is reached between 170° and 180° F., when the fibers change from 87% ring dyed to 100% completely dyed. Although PV is rated only 2 to leveling, these studies indicate that level fiber dyeings will be obtained with normal dyeing procedures.

Calcochrome Green SGV (Graph 12) has 89% of the fibers undyed at 170° F. and 94% ring dyed at 180° F. When the boil is reached, 93% of the fibers are completely dyed. Calcochrome Green SW (Graph 13) belongs to a slow dyeing, slow chroming class and shows a more gradual change from undyed to ring dyed. At 190° F., 73% of the fibers are still undyed and 27% ring dyed. At 200° F., 53% are undyed and 33% ring dyed. At the boil, 26% are still undyed and 70% are dyed.

Calochrome Brown PG (Graph 14) reaches a critical point between 130° F. and 140° F. At 130° F., 81% of the fibers are undyed, and 18% ring dyed, whereas at 140° F., only 29% are undyed and 71% are ring dyed. At 190° F., 68% are still ring dyed and 32% are dyed. At 200° F., 89% are completely dyed. These comparisons may be used again to illustrate the fact that the different members of each class of colors exhibit wide variations in their dyeing properties. However, our studies indicate that practically any top chrome color will give level results provided it is applied under the proper conditions of pH, temperature and time.

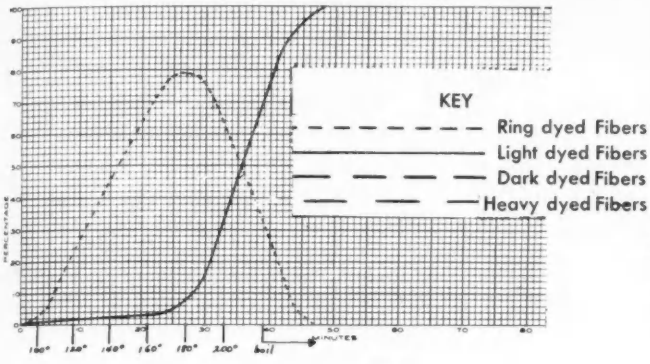
Meta Chrome Dyeing

Calcochrome Brown EB (Graph 15) and Calcochrome Brown RH (Graph 16) show an interesting contrast between two of the chrome browns dyed meta chrome. At 150° F., both show their maximum of ring dyed fibers: Brown RH having about 88% ring dyed and 10% light dyed, and Brown EB showing 85% ring dyed and 15% undyed. At 180° F., Brown RH has 55% light and 45% dark, while the Brown EB still is 100% ring dyed. In one-hour boil the Brown RH (Fig. 7) has reached 84% dark dyed and 16% light dyed. The Brown EB after 1 hour at the boil (Fig. 8) is still 90% light dyed and only 10% dark dyed. This shows the much slower rate of diffusion of the Brown EB and may account for its level dyeing rating of 1-2 in contrast with the better level dyeing rating of 2-3 for the Brown RH. In general, a level dyeing color penetrates or diffuses into the fibers at lower temperatures and within shorter periods of dyeing time.

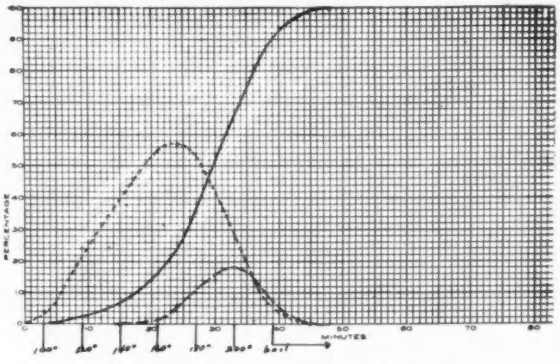
Top Chrome versus Meta Chrome

Alizarine Blue Black B was dyed by the top chrome method without after chrome and the meta chrome method for comparison. The top chrome dyeing (Graph 17) has 83% undyed and 17% ring dyed at 120° F. At 150° F., 100% of the fibers are ring dyed (Fig. 9). Between 200° F. and the boil, it changes from 87% ring dyed to 70% light dyed and 30% heavy dyed (Fig. 10). After boiling 8 minutes the conditions are reversed and 92% are dark dyed and only 8% are light dyed (Fig. 11). The meta chrome dyeing (Graph 18) changes between 130° F. and 150° F. from 61% undyed and 39% ring dyed to no undyed and 99% ring dyed (Fig. 12). At the boil the dyeing contains a maximum of light dyed fibers, 99% (Fig. 13) and then very slowly changes to dark dyed fibers. This is quite different from the top chrome method just described since it takes almost an hour's boil (Fig. 14) to reach the same amount of dark dyed fibers in the meta chrome as was obtained in 9 minutes' boil with the top chrome procedure.

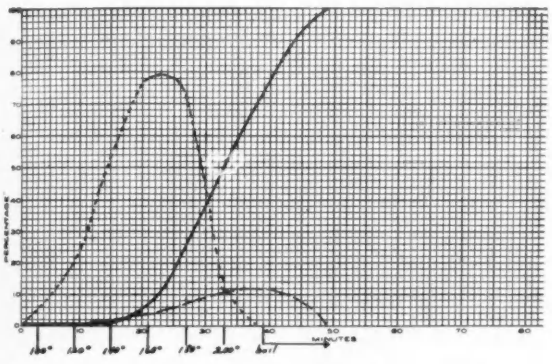
In both of the procedures, the dye exhausts and penetrates the fibers similarly until just before the boil is reached. At this point the top chrome bath continues to exhaust and, as can be seen from Graph 17, the light dyed fibers change over quickly to the dark dyed. In the case of the meta chrome bath, the chrome in the bath starts to



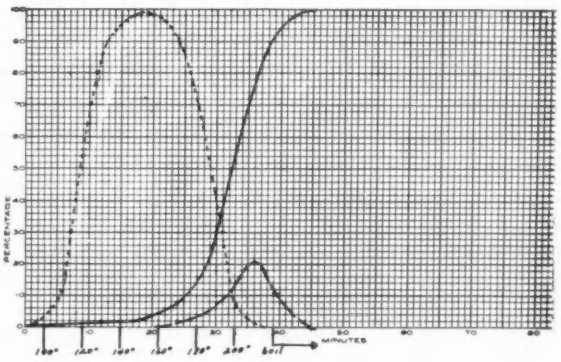
Graph 1 Calcocid Blue VS



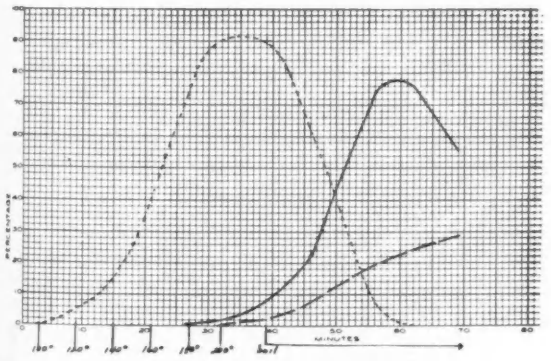
Graph 2 Calcocid Phloxine 2G



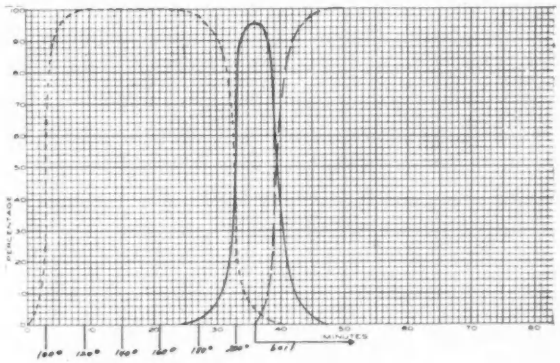
Graph 3 Calcocid Alizarine Blue SAPG



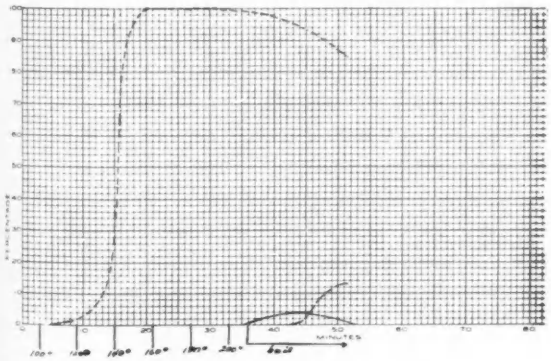
Graph 4 Calcocid Alizarine Blue SKY



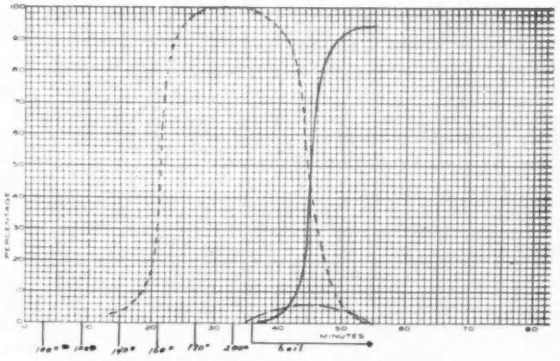
Graph 5 Calcocid Milling Orange 4R Conc.



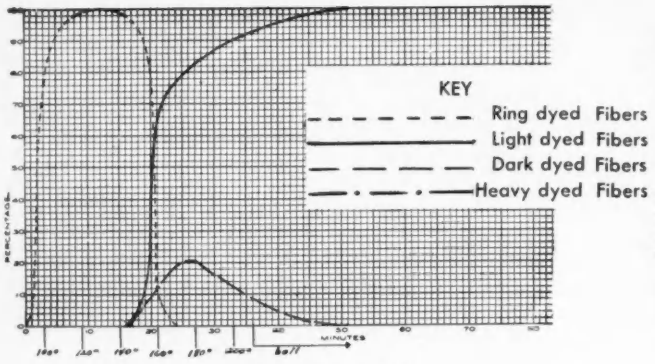
Graph 6 Calcocid Milling Red 3 R Conc.



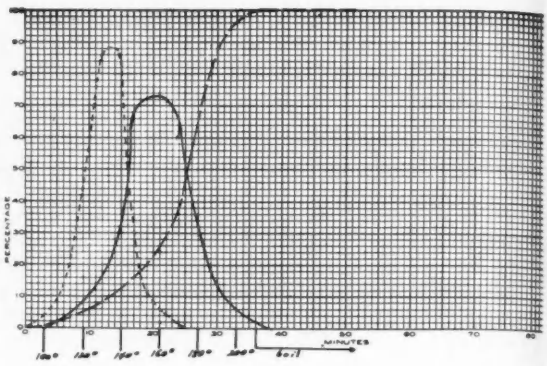
Graph 7 Calcocid Milling Red 3B



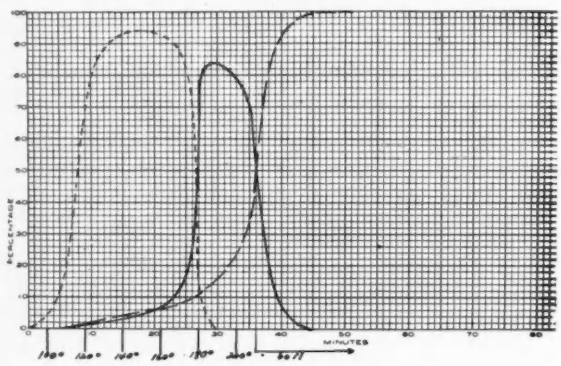
Graph 8 Calcocid Milling Red RC Conc.



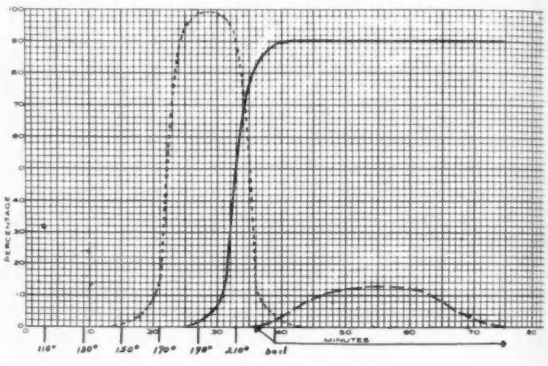
Graph 9 Calcochrome Violet B



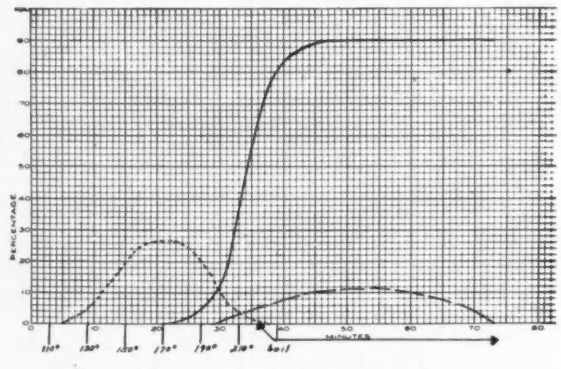
Graph 10 Calcochrome Alizarine Red SC



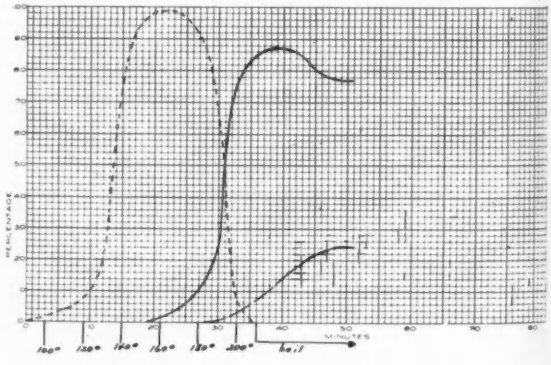
Graph 11 Calcochrome Black PV



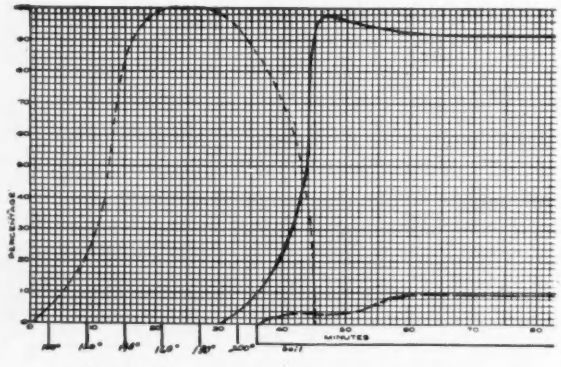
Graph 12 Calcochrome Fast Green SGV



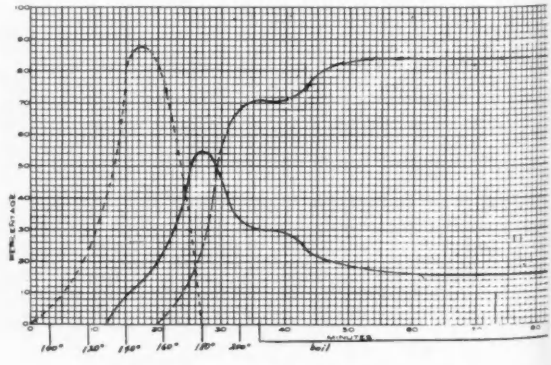
Graph 13 Calcochrome Green SW



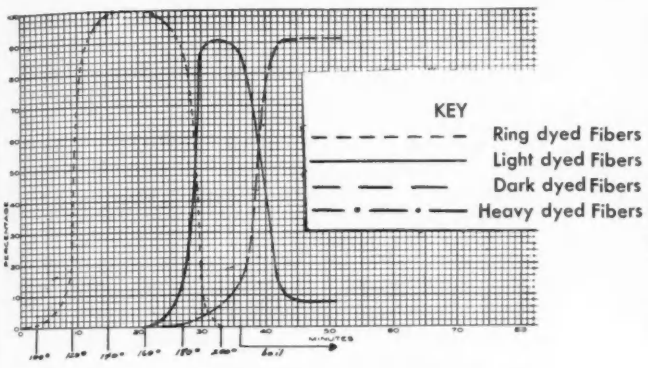
Graph 14 Calcochrome Brown PG



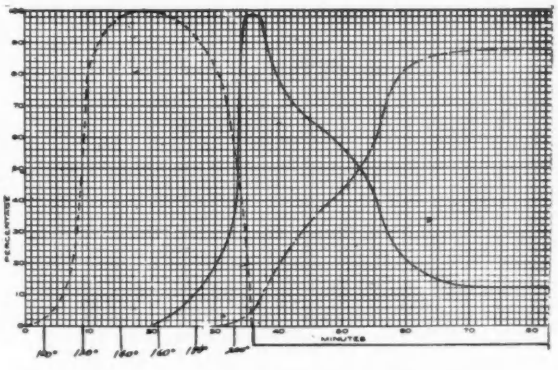
Graph 15 Calcochrome Brown EB



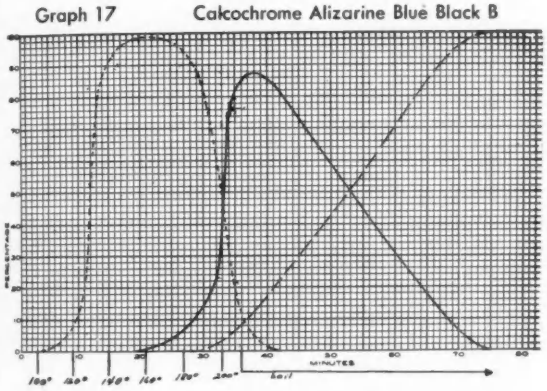
Graph 16 Calcochrome Brown RH



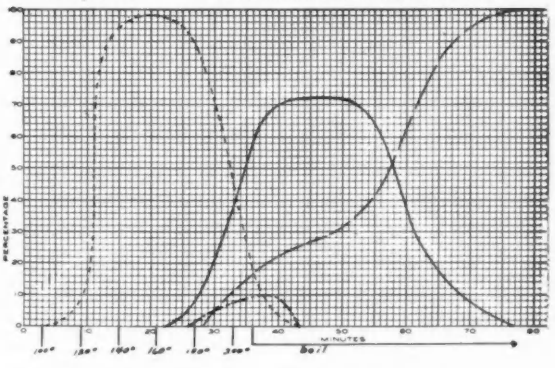
Graph 17 Calcochrome Alizarine Blue Black B



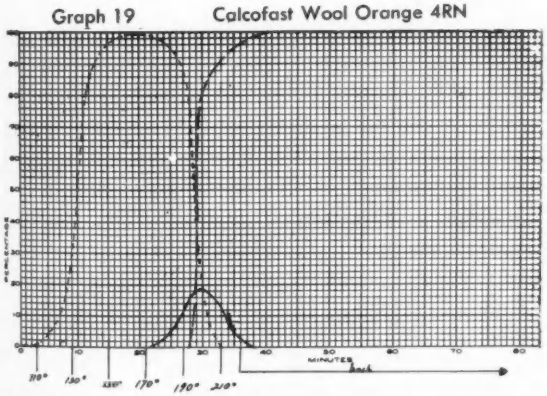
Graph 18 Calcochrome Alizarine Blue Black B



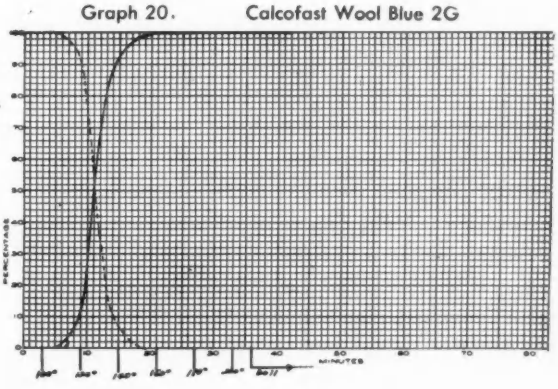
Graph 19 Calcofast Wool Orange 4RN



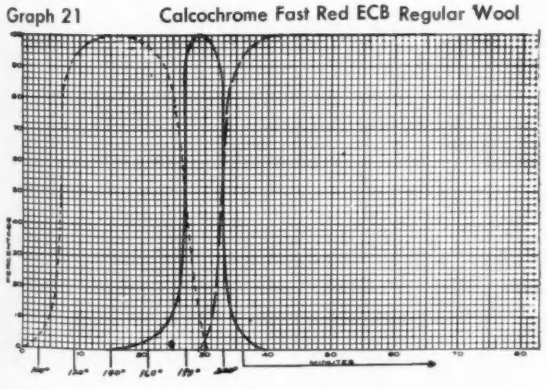
Graph 20. Calcofast Wool Blue 2G



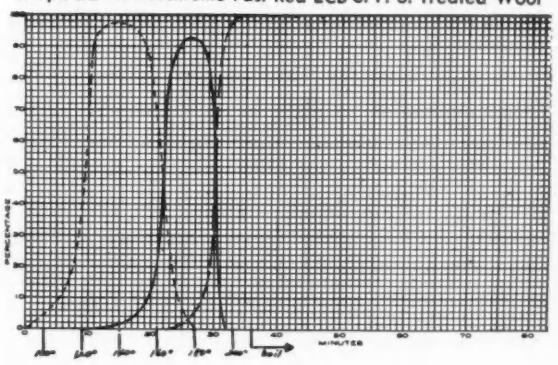
Graph 21 Calcochrome Fast Red ECB Regular Wool



Graph 22 Calcochrome Fast Red ECB S. F. S. Treated Wool



Graph 23 Calcochrome Fast Red ECB Alk. Potash Treated Wool



Graph 24 Calcochrome Fast Red ECB Peroxide Treated Wool

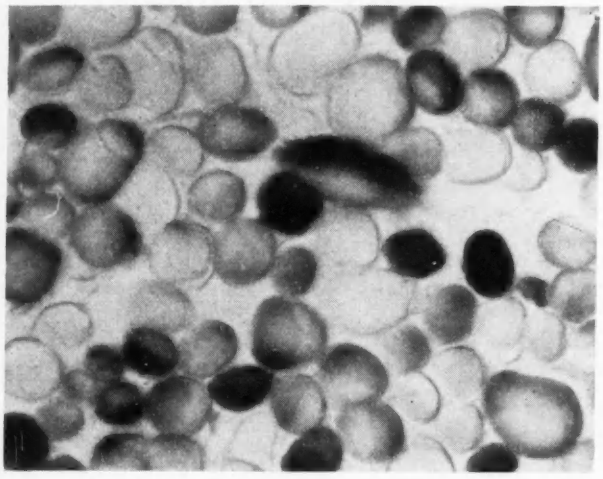


Fig. 3 Blue VS 180° F

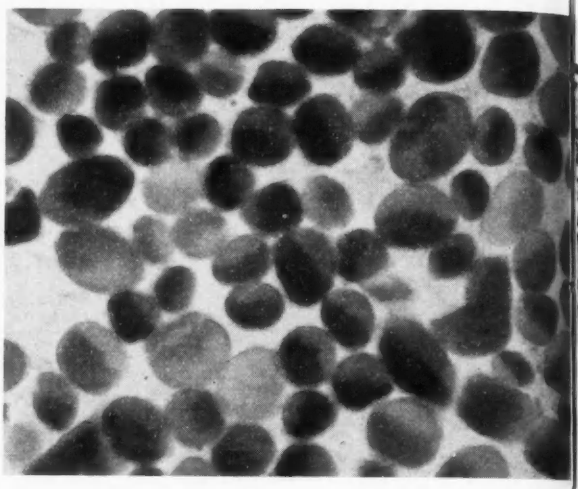


Fig. 4 Blue VS Boil 12 min.

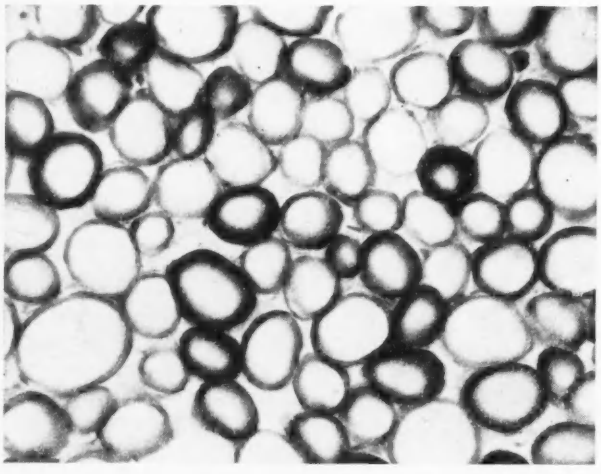


Fig. 5 Milling Orange 4R 200° F

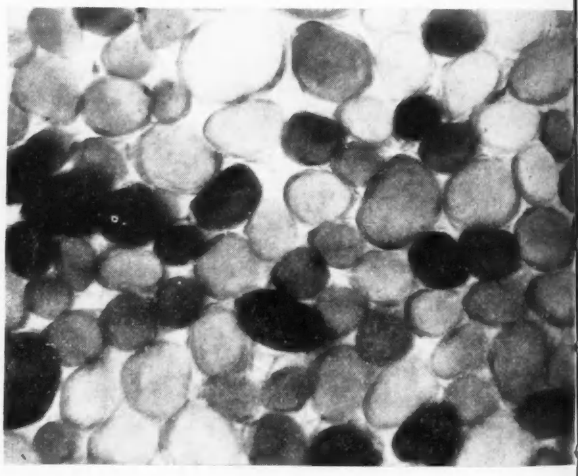


Fig. 6 Milling Orange 4R Boil 30 min.

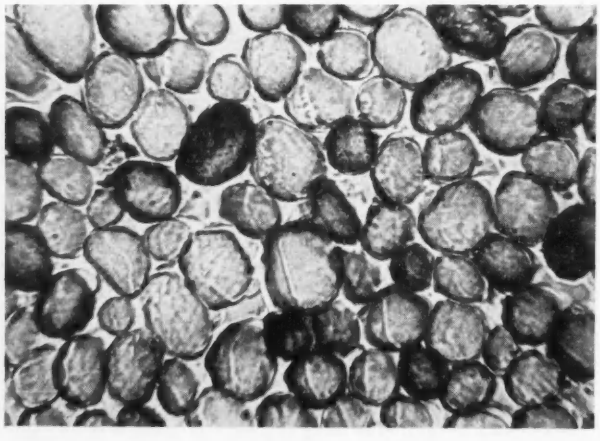


Fig. 7 Brown RH 60 min.

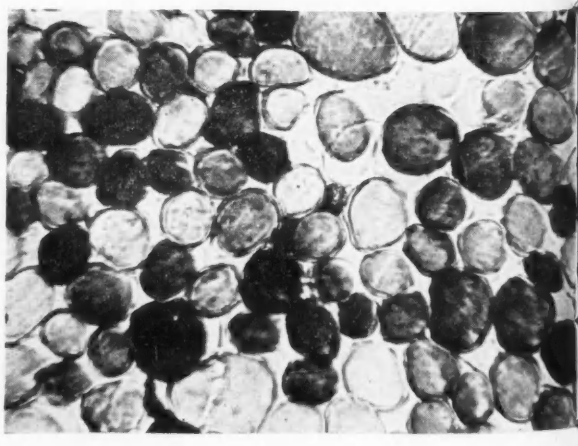


Fig. 8 Brown EB 60 min.

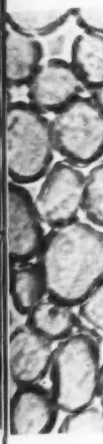


Fig. 9

Fig. 10

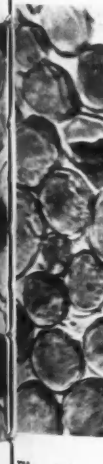


Fig. 11

ALIZARINE BLUE BLACK B

Topchrome Method

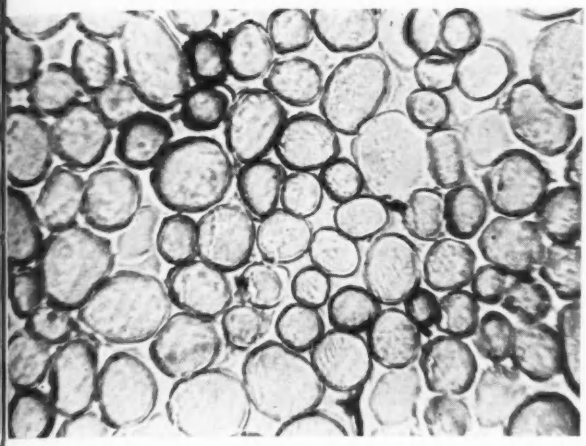


Fig. 9 — 150° F

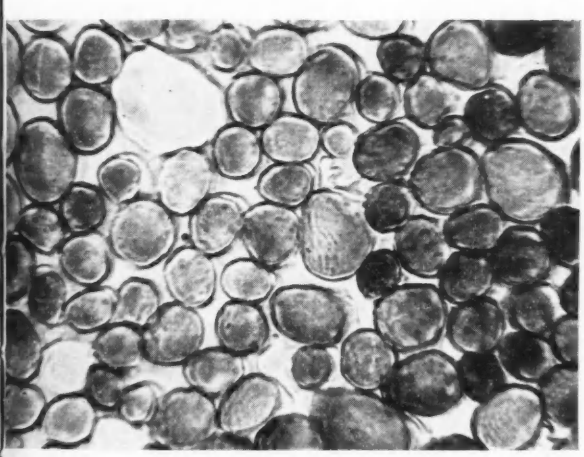


Fig. 10 — Boil

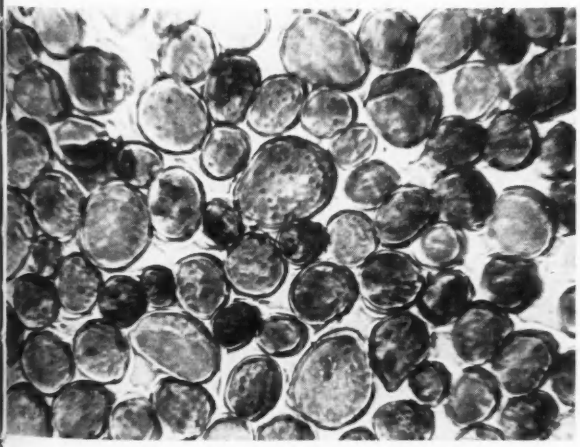


Fig. 11 — 9 min. boil

Metachrome Method

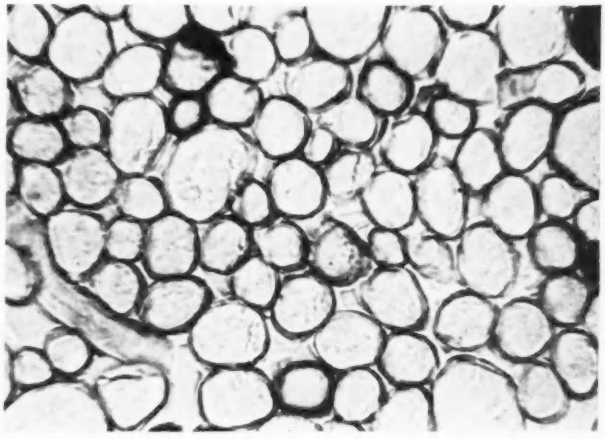


Fig. 12 — 150° F

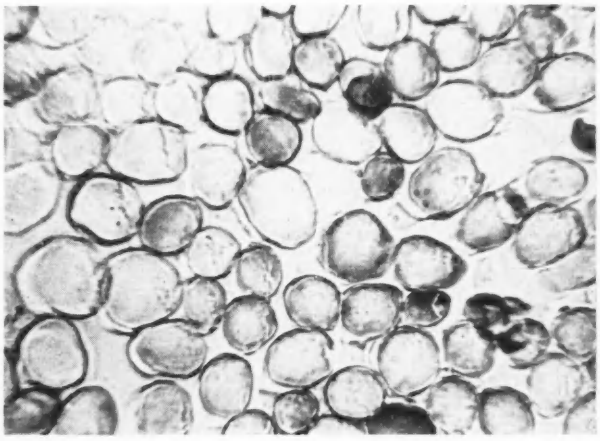


Fig. 13 — Boil

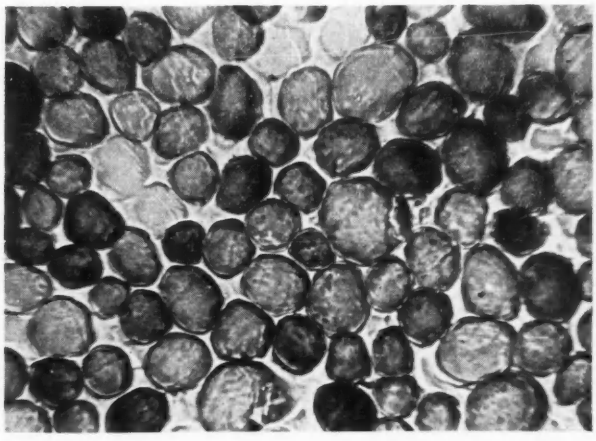


Fig. 14 — 60 min. boil

WOOL BLUE 2G

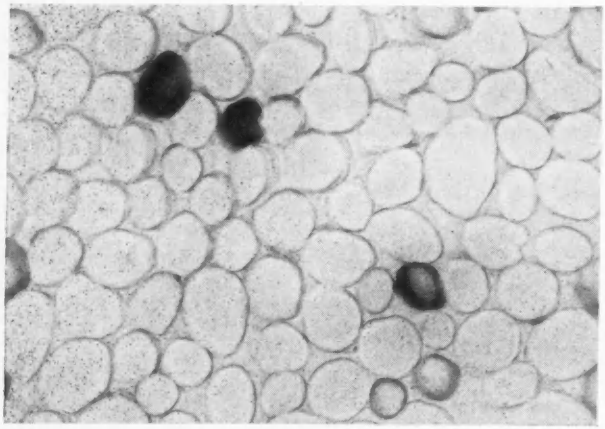


Fig. 15 130° F

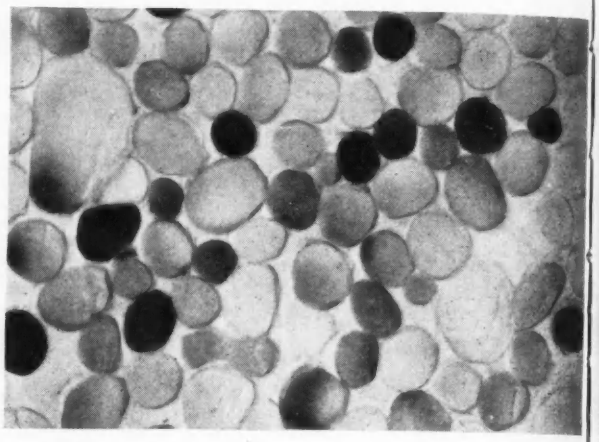


Fig. 16 Boil

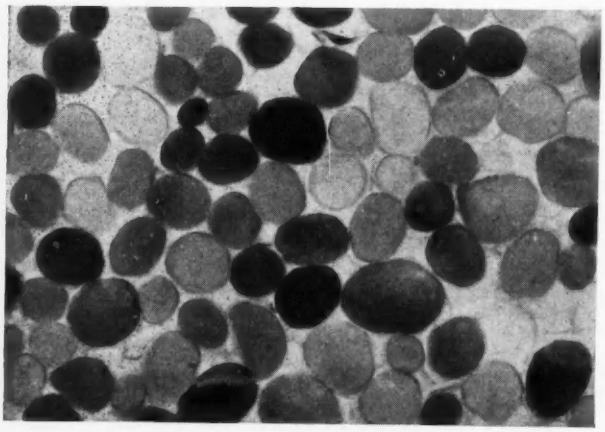


Fig. 17 Boil 15 min.

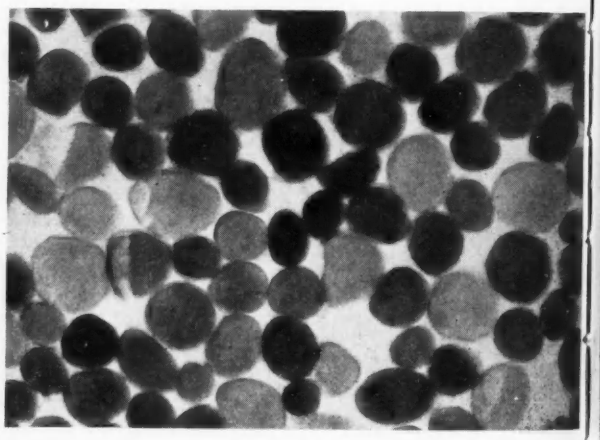


Fig. 18 Boil 1 hr.

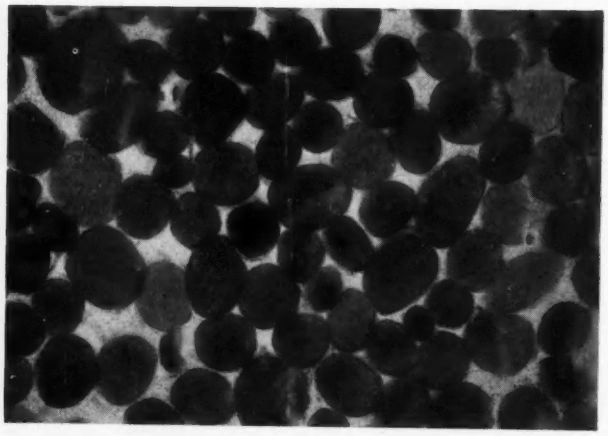


Fig. 19 Boil 1½ hrs.

Fig. 20

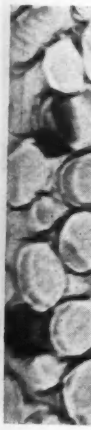


Fig. 22

Fig. 24

WOOL GREEN 3B

Untreated Wool

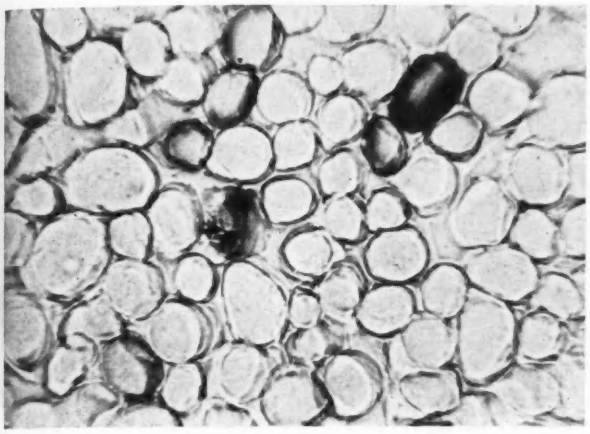


Fig. 20 — 140° F

Alcohol Potash Treated Wool

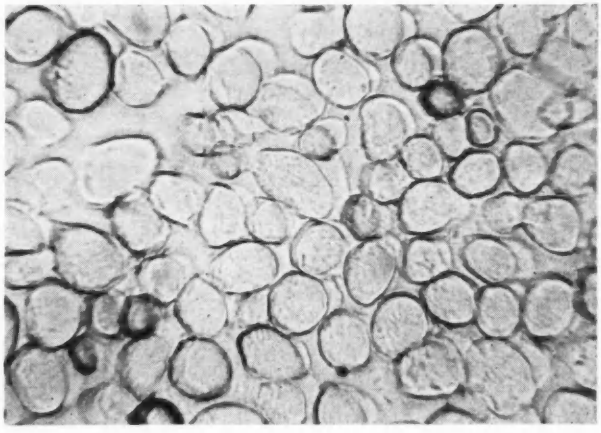


Fig. 21 — 140° F

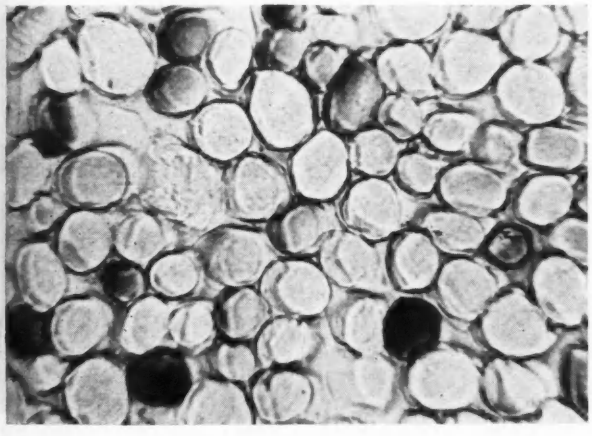


Fig. 22 — 190° F

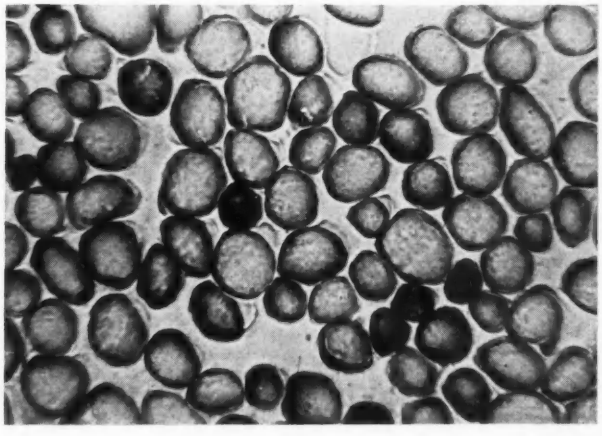


Fig. 23 — 190° F

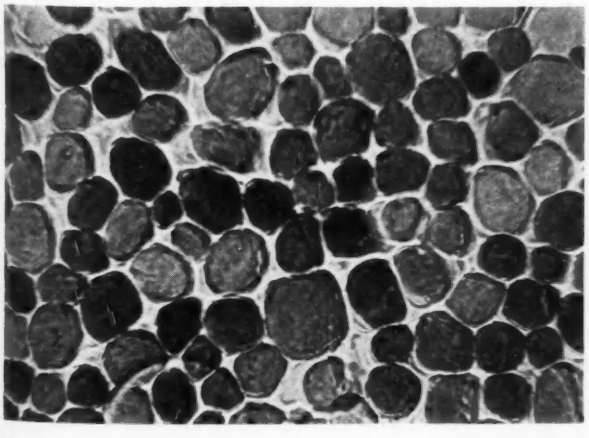


Fig. 24 — 1½ hr. boil

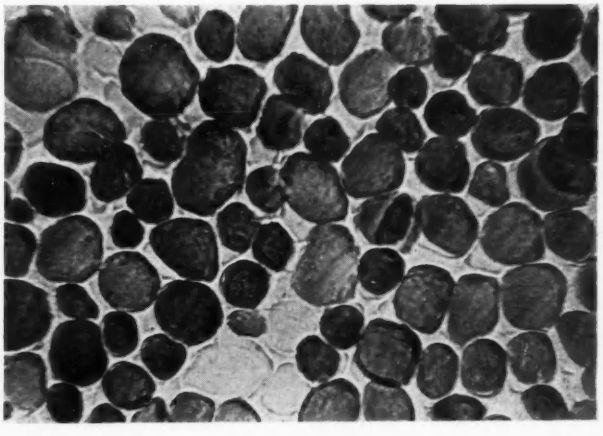


Fig. 25 — ½ hr. boil

combine with the dye as the temperature is raised and the chromium dye complex is formed at a much more rapid rate at the boil than at the lower temperatures. The rate of diffusion of this chrome dye complex into the wool is slower than that of the unchromed dye in our top chrome procedure and so the time necessary to reach complete dyeing is longer for the meta chrome process.

Calcofast Colors

Calcofast Wool Orange 4RN (Graph 19) and Calcofast Wool Blue 2G (Graph 20) are typical metallized dyes. These colors level best with 8 to 10% of sulfuric acid; and, while with lower percentages of acid they give more complete exhaustion of the dye bath, the dyeings are less level and the same richness of shade is not obtained.

Calcofast Wool Blue 2G dyed with 8% sulfuric acid shows very poor fiber levelness in the early stages (Fig. 15 at 130° F.) of dyeing, followed by practically 100% ring dyed at 150° F. At the time the dyeing reaches the boil, very poor fiber levelness exists (Fig. 16); 9% are ring dyed, 70% are light dyed, 16% of the fibers are dark dyed, and 5% are heavy dyed. As boiling continues the extremely heavy dyed fibers start to lose color and decrease in number, whereas the light dyed take up the color to form dark dyed fibers (Fig. 17). On boiling for 1 hour (Fig. 18) good fiber levelness is not obtained and the color is capable of further redistribution. Boiling for 1½ hours (Fig. 19) shows good fiber levelness since all of the fibers are dark dyed. This is a good example of a color which exhibits very poor fiber levelness during the early stages of dyeing but on long boiling the dye is distributed uniformly on all fibers and a level shade results.

The Calcofast Wool Orange 4RN is similar, but with this color (see Graph 19) fewer extremely heavy dyed fibers appear and the leveling takes place between the light and dark dyed. About the same total time of 1½ hours is necessary to obtain good fiber levelness for all of these colors. These studies of the metallized dyes show how this type of dye gives tippiness at the beginning of the dyeing and on continued boiling, levels out. The dye is absorbed first by fibers which are readily dyed and then with continued boiling in a strongly acid bath the color is gradually released by the dark dyed fibers and is absorbed by the more difficult to dye fibers and this results in a good level fiber dyeing.

Influence of Wool Fiber

As can be seen from the microscopical examinations, the wool fibers do not all dye at the same rate. This has been discussed in the previous papers of this series, but it should be emphasized that the condition of the wool will affect the critical temperatures. To show this, wool was given various pretreatments and dyeings were made to determine how the critical temperatures were changed.

On making a series of experiments using Calcochrome Fast Red ECB on wool pretreated in various ways, it was found that the greater the "damage" to the wool, the lower the temperature at which the fibers changed from undyed to ring dyed, and from ring dyed to completely dyed. Dyeing experiements on the regular scoured wool indicated (Graph 21) that the first critical point was reached between 130° F.-140° F., the second at 180° F.-190° F. Another experiment in which wool had been pretreated by bleaching in a 2-volume peroxide bath (Graph 24) made slightly alkaline with trisodium phosphate, reduced the first critical point to 120° F.-130° F. and the second to 160°F.-170° F. Pretreatment with alcoholic potash (Graph 23) by the method of Freney & Lipson[5] lowered the first point to 110° F.-120° F. and the second occurred at 170° F.-180° F. Boiling wool with 5% soluble sulfoxalate for 30 minutes (Graph 22) has a definite effect on the wool; this is proved by causing all of the fibers to become ring dyed during the first three minutes of dyeing time at 110° F. The second point was reached between 120° F. and 130° F. when the fiber count changed from 93% ring dyed at 120° F. to 88% fully dyed at 130° F.

Dyeings were also made on alcoholic potash treated and regular wool with a typical metallized dye. Samples of both removed at 140° F., 190° F., the boil, ½-hour boil, 1-hour boil and 1½-hour boil showed the diffusion of the dye into the individual fibers at these stages. At 140° F. for example, the regular wool (Fig. 20) showed only a few of the fibers ring dyed, while in the treated wool (Fig. 21) most of them had started to dye. At 190° F. the regular wool (Fig. 22) was quite fiber unlevel, some fibers being very dark while others were undyed. The treated wool (Fig. 23), at this temperature, was uniformly ring dyed. At the later stages, the regular wool leveled in 1½ hours (Fig. 24) as described previously in the case of the Calcofast colors, while the treated wool gradually built up to a level heavy shade in 30 mins. at the boil (Fig. 25). From this it can be seen that the alcoholic potash treatment made all the fibers dye uniformly and fiber levelness is obtained from the very start of the dyeing.

Since the same standard dye solutions and methods of application were used in all of these experiments on the various wools, the only variable was the wool. Previous studies[6] have shown that the first step in the course of dyeing is the removal of the dye from the dye bath and its deposition on the outer portions of the fibers in the form of rings. In wool dyeing, this deposition and diffusion of the dye into the fibers are governed by the type of dye, method of application, the condition of the epidermis layer and any fundamental differences in the wool. If the surface of the fibers is "damaged" by light and weather while still on the sheep, or by exposure to ultra-violet rays, by boiling in water, by chemical treatments, or by mechanical abrasion of the fibers after shearing, the dye can penetrate more readily into the fiber and the critical points will be reached at lower temperatures regardless of the type of dye.

It should be remembered that in this study the temperatures and observations were made on laboratory dyeings where critical temperatures may be reached more rapidly than in practical open machines. A boil in the laboratory

represents 212° F. while an open dye kettle can only reach 205°-208° F. Other work not reported here shows definitely that this difference of 5°-10° between laboratory and plant conditions may be very important because it affects the penetration and color value of a number of dyes.

SUMMARY

Practical dyeings have shown that certain temperatures are critical in the dyeing operation. At these temperatures, rates of exhaustion and color build-up change rapidly. Careful control at these critical points is therefore necessary so that level and well-penetrated dyeings of good color value are obtained. At temperatures below the critical points poor penetration and a lack of leveling occur due to the fact that, at the lower temperatures, days may be required instead of hours or minutes. The microscopical examinations show what happens to the individual fibers during the dyeing operation and these methods may be used to study the conditions so that better dyeing procedures can be developed.

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[2] Royer, G. L., Millson, H. E., AMERICAN DYESTUFF REPORTER *29*, p. 697 (1940).
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[6] Millson, H. E., Royer, G. L., AMERICAN DYESTUFF REPORTER *31*, p. 278 (1942).
[7] Goodall, F. L., *Jour. Soc. Dyers and Col. 54*, 45 (1938).
[8] Goodall, F. L., and Hobday, C. *Jour. Soc. Dyers and Col. 55*, 529 (1939).

DISCUSSION

Mr. Dalton: I would like to know, in view of what you have shown of the Calcofast dyes where you use a large percentage of sulfuric acid, do you want us to assume that the large amount of sulfuric acid damages the wool?

Mr. Millson: It has been stated that dyeing with metallized dyes with high percentages of acid damages the wool to a certain extent. As yet we have not been able to prove or disprove this statement by tensile strength measurements.

However, there has been quite a lot of work done on the stripping of wool dyed with metallized dyes. These tests prove that the wool is much weaker after stripping than wool dyed with ordinary acid colors. The average acid color requires anywhere from 2 to 4 per cent sulfuric acid, while the metallized dyes, unless some kind of salt is used, require from 8 to 10 per cent, depending upon the liquor stock ratio.

Mr. Dalton: When you consider some of the colors that don't show good level dyeing under the conditions in which you dyed them, did you vary the pH to see if fiber swelling affected the results?

Mr. Millson: We have done that to some extent, but we have no definite results to report.

Mr. Dalton: Have you done any more work to show that certain other dyes produce damaging results?

Mr. Millson: We have done some work, but have no results to report other than those already published.

Mr. Dalton: Is there any correlation between the molecular size of the dyestuff and the rate of diffusion?

Mr. Watkins: I believe that Mr. Goodall in the *Journal of the Society of Dyers and Colourists* in 1938 makes some such distinctions.

He separates dyes, as I recall it, into three classes, one of which is those which are molecularly dispersed at both low and high temperatures. He states that the smaller particle size permits the dye molecules to go freely into the fiber. In the case of Calcocid Blue VS it would seem to me that if they went freely in and out you would not have what we call ring dyeing until up to somewhere near 150 or 160 degrees. You haven't got any passing in and out of that color. The bath is exhausted at 160° as much as it is after boiling, but the dye has not diffused into the fibers.

Then, he has a second class of dyes. They are those dyes which are colloidally dispersed at a low temperature. Therefore, they go on unevenly. When high temperatures are reached, they pass over into a molecular dispersion and level very nicely. I suspect that Alizarine Blue SKY may be a dye of that type. You dye it at 150 degrees in an acid bath in comparison with the SAPG, and you have a much fuller dyeing of the Blue SKY at 150 degrees than you have of the SAPG. In cross sections the Blue SKY is not very level, and, looking at it closely, you haven't got a real honest-to-goodness dyeing.

Then, his third class is composed of those dyes which are colloidal all the way. Those are the dyes which are difficult to get level.

Mr. Christison: There is one slide which I am impressed by strongly. That is the one which showed the effect of the alkali treatment of wool, and it brings to my mind the eternal and everlasting controversy between the dyer and the finisher.

If pieces of material do not dye properly there is always an argument as to why; as we are all more or less human and prone to think that we have done our work properly, and that perhaps the other fellow hasn't been as careful as he should have been. The dyer is usually the last man to handle the goods, and he usually has to take the rap on anything that goes wrong.

When trouble does occur, there may, of course, be a dozen reasons why. There may be mixed-up batches; there may be differences in steaming; there may be differences in scouring, and other reasons why you shouldn't get level dyeings.

When they occur, I suppose a great many dyers immediately suspect that their goods have not been prepared properly and they give the goods the treatment that the dyer figures that the finisher should have given it. A great many times he will give the goods an alkaline treatment,

and in a great many instances the alkaline treatment may be an ammonia treatment, and, at times, it may be something even a little more vigorous. A great many times the trouble is, if not cured, at least alleviated, and the dyer feels that he has proof then that the goods contain material that should have been taken off. The materials he assumes have been taken off might be bad oils, or sizing material, or goodness knows what.

But, I think that the slide there illustrates what really does happen and why the good results are obtained. What happens is this: the alkaline treatment tends to damage the wool, and it makes the wool fiber itself more easy to penetrate, and the slide furthermore shows why streaks and other things disappear when the wool is given an alkaline treatment. It makes the wool fiber itself more easy to penetrate, and it shows the reason, when goods have to be treated because of streaks, why the wool then dyes solid because of an alkaline treatment. That slide is quite important.

Mr. Dalton: I don't see any relation between the depth of shade and the coarseness of the fiber. The slides show the color in the cross sections. Would surface color show the same variations as cross sections? I always supposed coarse fibers would become darker. In most of those cross sections I noticed that some of the finest fibers were not lighter but darker than the coarser ones.

Mr. Watkins: Of course, I have noticed that difference in size in cross sections, but I figured that the fiber isn't the same; all fibers aren't the same diameter all the way through, and, taking this cross section at any point, we have some sections of larger diameter and some of finer diameter all in the same quality of wool.

Dr. Royer: Some work we have published recently in the dyeing of two sizes of wool, 64's and 36's might be mentioned here. They were given an alcoholic potash treatment to equalize the affinity of all the fibers, so that they would all take up the same amount of dye with complete penetration of dye into the fibers. Cross sectional examination showed this to be true.

The rate of dyeing of the finer fiber is faster than the rate of dyeing of the coarse fiber because the smaller fiber, for equal weight, will have a greater surface area. If you take two samples off at the earlier stages of the dyeing, you will find the finer fiber very much darker than the coarse fiber due to the fact that in the earlier stages of the dyeing, it takes up the dye more rapidly, so it will therefore have exhausted more dye from the bath.

When you reach the end of the dyeing they both have the same amount of grams of dye per gram of wool and they will be exactly the same in cross section. You have the same unit amount of dyestuff per unit of wool. When we examine the fiber from the side, the darker fibers will be those of the larger diameter. The 64s, the finer fibers, will be very light in shade. The difference in this case will be considerable because of the great size variation.

The phenomena is explained as being due to a difference of surface area between the two different fibers. In other words, when we look at a fiber at the side, we are looking at the light reflected from the surface of the fiber and also the light which goes into the fiber. We can say there are two general types of reflection from any fiber. One is the reflection which will come back from the surface. This is very much similar to light coming off of a mirror, so that light will be reflected without ever getting to the place where the color is. The other is the light which goes into the fiber itself and comes back with some of the color. This is the body color of the material.

So, if we increase the surface area, which is what we do with the fine fibers, we get an increase in white light. We have a larger proportion of this surface light than of that which penetrated into the body of the fiber.

We then have the explanation for the lighter appearance of the fine 64's although they have exactly the same amount of dye as the 36's fibers. The fibers have been diluted with a certain amount of surface-reflected light.

Mr. Dalton: I noticed when the slides were being shown, except in one case, and that was with Sulphon Cyanine, that there was no procedure given. Was the procedure the same in the application of all the different types of dyes shown?

Mr. Watkins: The acid colors, that is, the level dyeing acid colors, were dyed with ten per cent anhydrous sodium sulfate and four per cent of sulfuric acid. The milling colors were dyed with ten per cent of sodium sulfate and two per cent of fifty-six per cent acetic acid.

Mr. Dalton: The reason I brought that up is this: would those conditions which were illustrated on those slides be the same if the conditions of dyeing were changed?

Mr. Watkins: I am very sure that in the case of the milling colors, if we dyed them with sulfuric acid, we would get a very different picture. That is something that I am a little bit interested in, but have had no opportunity to investigate it thoroughly. A number of years ago I had a request to dye up a twenty-gram piece of worsted top with the Milling Red RC. That is a Polar Red and it had to be level. We took all the precautions, and so on, and didn't get it level. One day, my assistant, in despair, made up a dye bath, put in four per cent sulfuric acid, brought it to the boil, dropped in the dry top, and let it alone. It came out perfectly level. So, you see, I don't know anything about dyeing.

Mr. Schmitt: In one dyeing, I think it was one of the milling reds, you had a critical point where the dye bath was exhausted. Yet, at the further end of the scale, your dyeing was probably twenty or thirty per cent heavier. How do you account for that? That was interesting. The bath was exhausted at the lower temperature, and yet, the maximum strength was not reached until you had reached the boil.

Mr. Watkins: It is exhausted and the dye is all on the

outside portions of the fiber, I matched that up with some other curves we had which showed the point at which the bath was exhausted, and I found in every case where I could find a comparison, that the point at which the bath was exhausted corresponded with the top of the curve for ring dyeing.

We haven't gone into that thoroughly, but it would seem to me that there is a sufficient number of cases to indicate that it really is a fact. You have the dye on there, but you don't really get its value until you boil it long enough to get the dye diffused into the fiber.

I think in one of the earlier papers, the case of Phloxine 2G is cited. It was dyed at 150 degrees, and the bath was completely exhausted, but it didn't look half as strong as one made in the regular way at the boil. If I remember, in that particular case, the dyeing made at 150 degrees which looked weak, was put back and boiled for half an hour, and it developed until it was equal in strength to the one that had been dyed and boiled all the way.

Mr. Schmitt: In other words, after diffusing to the inside of the fiber, you have a solid color all the way through and get the true strength.

Mr. Watkins: Yes, you get the true strength.

Mr. Christison: I would like to ask Mr. Watkins why he overlooked these wonderful penetrating agents to cure all these defects?

Mr. Watkins: I don't want to express my opinion of a lot of these curative agents. This is a friendly gathering.

Mr. Christison: It looks different when it is on the surface. It doesn't reflect the proper shade unless the dye is on the inside part of the wool.

Mr. Millson: There is a further point there, and that is if you take 100 per cent fully-dyed fibers so that none are any different than the others, and add five per cent of white fibers, you will not decrease the depth of shade by five per cent—you would decrease it by fifteen to twenty per cent. That is an important point. If you have very heavily dyed, moderately dyed, or undyed fibers, what ever the percentage of the undyed fibers is, it will penalize the depth of shade considerably.

It is the distribution of the dye that is important. Therefore, in Part II we pointed out that maximum exhaustion of the dye bath does not guarantee full or maximum color value. It is the distribution of the dye within the fibers that gives real color strength.

Mr. Christison: There is one other thing that I would like to ask about and that is this: what would the comparison be of, let us say, Brown EB on a chrome bottom as against a chrome top?

Mr. Millson: Top chrome was best, bottom chrome next, and metachrome next when levelness was considered. I don't think the proper method of applying bottom chrome colors has been developed.

The fastness rating of some chrome bottom dyes is below that of the top chrome dyes. If you both bottom-chrome and top-chrome, you increase the fastness of these same colors. I think that has been proved in practice quite a number of times. We consider that top-chrome and metachrome are of much greater importance, and, therefore, we have done most of our work on those two methods, rather than on the bottom-chrome.

Mr. Christison: Do you sometimes find that sodium sulfate has a damaging effect on your milling colors?

Mr. Watkins: I can't say that I have with usual amounts. But in endeavoring to get level dyeing and complete penetration on fur hat felt, I have noticed that if excessive amounts of Glauber's salt are used the felt is damaged to the point that you can stick your finger through it.

Mr. Christison: Is it a common practice to use Glauber's Salt in dyeing chrome colors? If so, why is it not commonly used on tops using chrome colors?

Mr. Watkins: On most of them I don't think it is of any advantage. It depends on the color. With some it doesn't appear to offer any advantage, but probably with others there is some advantage.

There are so many factors in the dyeing of wool, that I think it is almost too much for the ordinary mind. I think that there is unquestionably some chemical action between most of the acid dyes and the wool. Consider that along with what we have shown here. I can't tackle but two or three of these factors at one time.

Mr. Schmitt: These cross-sections indicate that you have fiber levelness. Now, how would those same dyes look if you examined the fiber on the surface, that is, if you examined the fiber from end to end, the whole fiber? Would you have the same degree of fiber levelness, particularly in the case of Brown EB and Brown RH? There is a difference in the fiber levelness, but when you examine those same dyeings, those same fibers on the side, longitudinally rather than on cross-sections, could you still say that they have the same degree of fiber levelness?

I can see why a man dyeing pile fabrics would be very much interested in why those would be good when you are looking down on the top of the fiber cut cross-wise. But, take those same fibers and lay them down on the side, the way we look at them on a piece of cloth—are these findings equally indicative in that case? I would say yes in the case of Blue VS, but would it hold true in the other colors?

Mr. Millson: In the two dyeings that we made the EB was not as level as the Brown RH.

In some of the earlier work on this we showed one example of a dyeing that was quite unlevel in longitudinal view. That was where dye was precipitated on the outside of the fiber by the addition of sulfuric acid and practically all of the color value was lost. When the wool was treated with ammonia so that the color could be re-dissolved and put back into the dye bath in a soluble form and then exhausted with acetic acid, the shade changed from a light orange-tan color to a deep brown. Again, it shows

that the deposition and the condition of the dye on the outside of the fiber play an important part.

Dr. Royer: From a microscopical viewpoint, the answer is this: if you look at equal thicknesses, they will be equal from the side view, as well as on the end or cross sectional view. The reason for making the cross-sectional study is so that we can look at a large number of fibers at once. If you look at the longitudinal view, you are limited to fewer fibers in the field at the same time and you have to re-focus and there is a difficulty in making a comparison.

In cross section the thickness is the same, and we can therefore study the variation in dye content from fiber to fiber. The phenomenon of fiber levelness is probably more important when we are looking at the wool from the side than when it is viewed from the end.

Mr. Christison: You mean from the side view?

Dr. Royer: Yes.

Mr. Christison: That is where we see the condition?

Dr. Royer: Yes.

Mr. Christison: That is why I am wondering if these microscopic photographs are jibing with what we see on the side.

Dr. Royer: That is the very reason the phenomenon is important. I want to keep away from the scientific explanation of it as much as I can, but the scientific explanation is based upon the relationship between the light that comes from the surface and the reflections which are coming from within the fiber where the dye is located.

FUTURE MEETINGS, PHILADELPHIA SECTION

THE next two meetings of the Philadelphia Section will be held on March 10th and April 21st at the Engineers' Club of Philadelphia, 1317 Spruce Street, Philadelphia, Pa. It is to be noted that the dates and meeting place have been changed from the original schedule.

At the March 10th meeting William A. Wolhar, superintendent of bleaching, dyeing and finishing at the Rosemary Manufacturing Co., Roanoke Rapids, N. C., will speak on "Screen Printing." This will be supplemented with moving pictures.

MEMBERSHIP APPLICATIONS

Corporate

H. W. Butterworth & Sons Co., Mathieson Alkali Works, Inc.; Calgon, Inc., Nicetown Dye Works; Chelten Dye Works, Owens-Corning Fiberglas Co.; Eagle Dyeing & Finishing Co., Pee Dee Manufacturing Co.; Hart & Foster Co., Rosemary Manufacturing Co.; Kali Manufacturing Co., Southern Franklin Process Co.; Alex. Kerr Bro. & Co., Universal Dye Works; Masland Duraleather Co., Victor Dye Works.

Senior

Pierre Bonnett—Chemist, Durham Dye Works and Swiss Bleach. & Lace Finishing Co., Weehawken, N. J. Sponsors: W. R. Zimmerle, E. Schlaginhaufen.

Walter T. Bunce—Manager, Arnold Hoffman & Co., Inc., Charlotte, N. C. Sponsors: T. R. Smith, P. S. Gilchrist.

Frank P. Centrelli—Head Dyer, Colonial Piece Dye Works, Inc., North Bergen, N. J. Sponsors: P. J. Kennedy, T. F. O'Brien.

William Garwood Darrow—Textile Chemist and Colorist, National Aniline Div., Allied Chemical & Dye Corp., New York, N. Y. Sponsors: W. A. Holst, Jr., A. K. Gyzander.

George J. Dolan—Asst. Hosiery Dyer, Wayne Knitting Mills, Fort Wayne, Ind. Sponsors: V. Hartquist, L. Hoehn, Jr.

Theodore W. Durand—Overseer of Dyeing, Belleville Woolen Co., Allentown, R. I. Sponsors: J. H. Gormley, Jr., I. L. Blackmer.

Mary Deck Hale—Chemist, National Association of Dyers & Cleaners, Silver Spring, Md. Sponsors: H. Schlenker, R. J. Singer.

Edward R. Healy—General Supt., Textile Printing & Finishing Co., Lebanon, Pa. Sponsors: H. N. Craig, F. R. Byrod.

Louis F. Koberlein—Research Chemist, Interchemical Corp., New York, N. Y. Sponsors: K. L. Dorman, L. M. Shafer.

Dean M. Lewis—Secretary and Treasurer, Colonial Piece Dye Works, North Bergen, N. J. Sponsors: P. J. Kennedy, T. F. O'Brien.

Carl M. Marberg—Research Chemist, Interchemical Corp., New York, N. Y. Sponsors: H. B. Sturtevant, J. C. Martin.

George B. Martin—Sales and Tech. Service, General Dyestuff Corp., Philadelphia, Pa. Sponsors: B. C. Bond, A. E. Raimo.

Gordon Levis Nelson—Textile Colorist, National Aniline Div., Allied Chemical & Dye Corp., New York, N. Y. Sponsors: K. G. Morton, J. E. Loughlin.

Paul L. Oertel—Textile Colorist & Chemist, National Aniline Div., New York, N. Y. Sponsors: W. A. Holst, Jr., A. K. Gyzander.

Roy A. Pizzarello—Research and Development Chemist, Interchemical Corp., New York, N. Y. Sponsors: K. L. Dorman, L. M. Shafer.

John James Rossi—Boss Dyer and Finisher, Belleville Woolen Co., Allentown, R. I. Sponsors: J. H. Gormley, Jr., I. L. Blackmer.

Louis J. Villa—Supervisor of Textile Lab., Bur. of Standards, Montgomery Ward & Co., Chicago, Ill. Sponsors: A. T. Brainerd, J. G. Stott.

Junior

Frank Broadhead—Textile Chemist, Pacific Mills, Lawrence, Mass. Sponsors: J. N. Dalton, E. R. Rutter.

Philip D. Caine—Ensign, U. S. Navy. Sponsors: C. L. Daley, H. C. Chapin.

Clarence L. Cook—Chemist, Cleveland Worsted Mills Co., Ravenna, Ohio. Sponsors: R. C. Anderson, H. W. Dingee.

Joseph A. Kling—Textile Inspector, Quartermaster Depot, Philadelphia, Pa. Sponsors: C. Baeringer, C. B. Wood.

Peter George Kolupaev—Chemical Engr., Research Dept., Slatersville Finishing Co., Slatersville, R. I. Sponsors: L. A. Stanley, B. A. Heslin.

Francis E. Mosher—Textile Chemist, Pacific Mills, Worsted Div., Lawrence, Mass. Sponsors: J. N. Dalton, E. R. Rutter.

Cecil Mae Patton—Dyer, Shannon Hosiery Mills, Inc., Columbus, Ga. Sponsors: N. Johnston, L. M. Boyd.

MEETING, RHODE ISLAND SECTION

A MEETING of the Rhode Island Section was held on Friday evening, November 26th, at 8:00 P. M. in the hall of the Providence Engineering Society. About 75 members and guests were present.

The topic of the evening was "The Crown Tested Plan," a comprehensive explanation of which was given by Mr. Arthur R. Wachter, of the Crown Tested Dept. of American Viscose Co. This paper and the question-and-answer period which followed will be published.

Roland Brown of the Brown University athletic faculty showed a film of football plays of the Brown-Yale game. The meeting adjourned at 10:15 P. M.

Respectfully submitted,

ROBERT W. JOERGER, *Secretary.*

PIEDMONT SECTION PLANS

HENRY B. DIXON, Chairman of the Piedmont Section of the American Association of Textile Chemists and Colorists, presided at a meeting of the officers of this section at the Hotel Charlotte Saturday, January 8th. Officers in attendance included—

Sidney M. Cone, Vice-Chairman, Greensboro, North Carolina; Leland G. Atkins, Secretary, Charlotte, North Carolina; Wyss L. Barker, Treasurer, Charlotte, North Carolina; Dr. R. E. Rupp, Councilor, Lyman, South Carolina.

Members of the Sectional Committee present included—

Thorwald Larson, Charlotte, North Carolina; R. Bertrand Macintyre, Graham, North Carolina; William A. Wolhar, Roanoke Rapids, North Carolina; H. H. Field, Greenville, South Carolina.

Tentative plans for the three meetings to be held later in the year were made. A Spring meeting will be held in Greenville, South Carolina, March 25, at the Poinsett Hotel; the June meeting will be held in Winston-Salem, North Carolina with Bert Macintyre in charge of arrangements; the annual meeting will be held in Charlotte, North Carolina in November with William A. Wolhar and Thorwald Larson in charge.

20th Anniversary Meeting

The Piedmont Section was organized 20 years ago (October, 1944). Appropriate plans are being made for the 20th Anniversary celebration to be held in Greenville, South Carolina in March. Sectional Committeeman Hyman Field will be in charge of arrangements. It is hoped that all the past Chairmen of the Piedmont Section will be present on this occasion. The following have served as Chairmen of the Piedmont Section during the past 20 years—

Mr. Brown Mahon, Professor Doggett (deceased), Mr. Harold M. Chase, Mr. Malcolm McKenzie, Mr. Leonard Little, Dr. Charles Mullin, Mr. H. A. Barnes, Mr. S. L. Hayes, Mr. R. M. Mitchell, Mr. John L. Crist, Mr. A. R. Thompson, Jr., Mr. George P. Feindel, Mr. Paul Haddock (deceased), Mr. Chester Eddy, T. R. Smith, Dr. R. E. Rupp, A. Henry Gaede, H. E. Keifer, Louis Boyd, T. W. Church, Jr., C. Morris Rabold.

Further details regarding the 20th Anniversary meeting will be made public at a later date.

Hotel reservations should be made directly with the Poinsett Hotel; banquet reservations should be made through Secretary Leland G. Atkins, Southern Dyestuff Corporation, Charlotte, North Carolina.

MEETING, PHILADELPHIA SECTION

A MEETING of the Philadelphia Section was held on January 14, 1944 in the Pennsylvania Room at the Hotel Philadelphian, Philadelphia, Penna. An informal dinner preceded the meeting.

Lieutenant Colonel James Barrett Brown, U. S. Medical Corps, Valley Forge Hospital, Valley Forge, Penna., delivered a talk on "Textiles as used in Plastic Surgery." This short talk was accompanied by slides and moving pictures in technicolor.

The War Department showed moving pictures with sound effects of actual captured German and Japanese film.

James P. Conaway, ex-Chairman, introduced Mr. Boyce C. Bond as new Chairman for 1944.

There were 93 present at this meeting.

Respectfully submitted,

A. E. RAIMO, *Secretary.*

• CALENDAR •
OF COMING EVENTS

Meeting, Council, New York City, April 21, 1944.

Meeting, Research Committee, New York City, April 22, 1944.

Meeting, New York Section, Downtown Athletic Club, 19 West St., New York City, February 4, 1944. The program will consist of a symposium on Synthetic Fibers and Their Future Development. Speakers and subjects will be: Dr. Harold DeWitt Smith, A. M. Tenney Associates, "Acetate"; O. B. Bromley, Aralac, Inc., "Aralac"; C. K. Seid, American Bemberg Co., "Bemberg"; R. A. Ramsdell, Nylon Division, E. I. du Pont de Nemours & Co., Inc., "Nylon"; Dr. Frederic Bonnet, American Viscose Corp., "Viscose and Vinyon." Dinner at 7:00 P.M. Meeting at 8:00 P.M.

Meeting, Mid-West Section, Bismarck Hotel, Chicago, Ill., February 12, 1944. Annual Meeting and Election of Officers. Meeting at 3:30 P.M., Dinner at 7:30 P.M.

Meeting, Rhode Island Section, February 25, 1944.

Meeting, Philadelphia Section, Engineers Club of Philadelphia, 1317 Spruce Street, Philadelphia, Pa., March 10, 1944. Speaker: William A. Wolhar, Rosemary Manufacturing Co., Roanoke Rapids, N. C., "Screen Printing," supplemented by motion pictures. Note change in date and place.

Meeting, Piedmont Section, Poinsett Hotel, Greenville, S. C., March 25, 1944.

Lapel buttons, bearing the seal of the Association can be purchased by members in good standing, from the Secretary, for $1.50 each.

• JOINS MORELAND CHEMICAL

J. W. Ivey of Charlotte, who for the past fifteen years has been with the Mathieson Alkali Works, has resigned his position with that company to accept a position as manager of the Heavy Chemical Division of the Moreland Chemical Company of Spartanburg, S. C.

J. W. Ivey

The Moreland Chemical Company, of which Paul C. Thomas is President, manufactures sizings, soaps and finishing products, and are distributors of a complete line of textile and industrial chemicals.

Upon completion of his education at Georgia Tech., Mr. Ivey was connected with The Dixie Mercerizing Co. of Chattanooga, Tenn. He entered the employ of Mathieson Alkali as a member of the Sales and Technical Department, but for the past three years has devoted his entire time to technical research and the development of new products particularly applicable to the textile industry.

Mr. Ivey has been active in the American Association of Textile Chemist and Colorist, as well as other organizations and is now Secretary and Treasurer of the Carolina-Piedmont Section of the American Chemical Society.

• TEXTRON FELLOWSHIPS

Rhode Island School of Design Textile School has just received $50,000 from the Atlantic Rayon Corporation of Providence, Rhode Island, for the purpose of establishing two annual Textron Fellowships of approximately $1,200 each, William D. Fales, head of the Textile School, has announced.

The award is to be given each year to two senior students, either men or women, one of whom may have completed the Bachelor of Science course in Textile Engineering and the other the Bachelor of Fine Arts course in Textile Design.

Based on a thesis covering some phase of the rayon industry, scholastic ability, and apparent executive qualifications of the individual, the award will entitle the recipients to a year's training in industrial establishments and approximately $1,200 during that time.

A booklet outlining the scope and purpose of the Fellowships is being prepared. All inquiries should be made to the Director of Admissions, Rhode Island School of Design, Providence 3, R. I.

• BOND DRIVE

Representatives of the Chemicals Industry in New York met Wednesday, January 12, 1944, at the Uptown Club, 60 East 42nd Street, and planned a 100 per cent canvas of all employees and executives within the industry to further the sale of Fourth War Loan bonds. The meeting was called by Charles S. Munson, president of the Air Reduction Company, Inc., as chairman of the Chemicals Divisions of Commerce and Industry of the War Finance Committee.

Mr. Munson said that through committeemen who have volunteered their services, each of the 350 concerns will be contacted in an effort to have each of the 65,000 employes within the industry made personally acquainted with the facts that bonds will speed victory by providing means of purchasing war materials, and further that the bonds are the world's safest investment.

W. Randolph Burgess, State Chairman of the War Finance Committee, said that the Chemicals Division of Commerce and continue through February 15. He said that the employees and executives are being asked to subscribe to $581,000,000 worth of bonds in New York City, and that the State quota is $911,000,000.

William E. Cotter, Director of the Commerce and Industry Division, explained the mechanics of the campaign, and the public relations job which the volunteer men have offered their services for.

In the campaign among the Chemicals Industry, Edward H. Anchors of the Air Reduction Company, Incorporated, will act as liaison officer. The Committeemen who have volunteered their services include: H. M. Albright, vice-president U. S. Potash Co.; I. Alenbik, president, Albi Chemical Corp.; E. O. Heyl, vice-president Albi Chemical Corp.; B. J. Tyler, secretary, Albi Chemical Corp.; O. N. Frankfurter, sales manager, Latin-American Export Sales, Heyden Chemical Co.; L. F. Loutrel, president, Shawinigan Products Corp.; George A. Bennington, president Mutual Chemical Co. of America; Howard Berry, vice-president, Mathisen Alkali Co.; John J. Butler, Jr., West Virginia Pulp & Paper; Reid L. Carr, president, Columbian Carbon Co.; C. M. Schultz, assistant to president, American Agricultural Chemical; Robert H. deGreeff, R. W. Greeff & Co.; Henry W. Denny, vice-president, Commercial Solvents Corp.; Ralph E. Dorland, manager N. Y. Office, The Dow Chemical Co.; A. T. Loeffler, general branch manager, Monsanto Chemical Co.; Willard D. Smith, executive vice-president, Frederick H. Levey Co.; P. F. Lavedan, president, Liquid Carbonic Co.; C. A. Mace, secretary, Synthetic Organic Chemical Ass'n.; Milton F. Martin, U. S. Industrial Chemical; Charles F. McKenna, Jr., General Aniline & Film Corp.; W. J. Reich, Jr., General Sales Manager, Carbide & Carbon Chemicals Corp.; Charles M. Richter, president, Pharma Chemical Corp.; W. C. Shallcross, manager special products sales, Solvay Sales Corp.; Irving H. Taylor, president, Merchants' Chemical Corp.; A. Lucian Walker, Jr., Texas Gulf Sulphur Co.; Albert Woods, Chilean Nitrate Sales Corp.; Stephen J. White, vice-president, Niagara Alakali Co.; Langbourne M. Williams, Jr., president, Freeport Sulphur Co.; George F. Handel, Cincinnati Chemical Works, Inc.; Albert M. Kahn, president, Consolidated Products Co.; Louis Lara, J. M. Huber, Inc.; Gilbert E. Grogan, American Cyanamid Co.; M. A. Solmasen, Pirolin Co.; William C. Keeley, vice-president of Air Reduction Company; H. J. Hufnagle and H. R. Salisbury.

• ADVISORY COMMITTEE

The Advisory Committee on Ultimate Consumer Goods of the American Standards Association at its meeting on January 13, 1944, in New York voted to develop standard definitions of technical terms for commodities sold at retail, as soon as possible. It is the object of this committee to produce a "dictionary" of the common terms used in the retail trade. This project does not necessarily include an attempt to draw up specifications for the commodity itself, but is an effort to provide a basis for agreement on the terms ordinarily applied to consumer goods, and to remove the basis for confusion and misunderstanding. The terms to be defined first will probably be those connected with the cost-of-living items. Work on the project will start immediately.

Irwin D. Wolf, Vice-President of Kaufmann Department Stores in Pittsburgh, Pa., representing the National Retail Dry Goods Association, was reelected Chairman of the ACUCG, and Dr. Dorothy Houghton, on the staff of Teachers College, Columbia University, and representing the American Home Economics Association, was elected Vice-Chairman.

• JOINS INTERCHEMICAL CORP.

Dr. A. E. Gessler, Director of Research for Interchemical Corporation, has announced that Dr. Donald Price, formerly Technical Director, Organic Research Laboratory, National Oil Products Co., Harrison, N. J., has joined Interchemical's research staff to co-ordinate their research projects in the pharmaceutical and fine chemical fields.

Dr. Price took his Ph.D. degree at Columbia in 1929 and afterward spent two years in post-doctorate research in Europe at the universities of Cambridge and Munich. He was a member of the Columbia Faculty until 1936 when he joined the staff of the National Oil Products Co.

Dr. Price is a Councillor of the American Chemical Society, a member of the Executive Committee of the American Section of the Society of Chemical Industry, Vice Chairman of the Technical Program Committee of the New York Section of the A.A.T.C.C., and Vice President of the American Institute of Chemists. He joined Interchemical as of January 15th.

• CONTINUOUS BLEACHING

Continuous bleaching of cotton goods in the open width is the most recent step in this type of textile processing as developed by the Electrochemicals Department of E. I. du Pont de Nemours & Company.

The new method is in operation at the Riverside and Dan River Cotton Mills, Inc., Danville, Va.

Handling piece goods in the open width in the bleachery is an extension of continuous bleaching of textiles in rope form which was announced by the Du Pont Company a year ago. The process is now satisfactorily handling the heavier fabrics demanded by the armed forces.

The new process shows savings, as compared to older methods, particularly in chemical and steam requirements. It also has the advantage of being continuous from grey storage to dry cans, eliminating the bleach house delays of batch processes and permitting adequate simple control.

Basically, the operation includes the usual caustic soda treatment, followed by a water wash, then a hydrogen peroxide bleach treatment and a subsequent wash. Technique and equipment used in these steps is new.

The goods, handled always in full open width, is continuously saturated and heated, held in bleaching chambers for periods of one hour, and continuously withdrawn from the system, in bleached form, for immediate delivery to the drying cans.

It is stated that continuous treatment of heavy fabrics, which are preferably handled in open width, plus operating savings and simple, straight, line flow of goods are the significant features of this new process.

• Classified Advertisements •

POSITION WANTED: Hosiery Dyer. 17 years' experience covering all types of dyes and a wide variety of fabrics. Draft exempt. Write Box No. 474, American Dyestuff Reporter, 440 Fourth Ave., New York, 16, N. Y.

WANTED—Graduate chemist with 2 or 3 years experience in dyeing rayon, cotton and silk for progressive rayon dyehouse. Write Box No. 502, American Dyestuff Reporter, 440 Fourth Ave., New York 16, N. Y.

WANTED: Textile chemist with experience in testing for permanent position in New York laboratory. Write Box No. 505, American Dyestuff Reporter, 440 Fourth Ave., New York 16, N. Y.

WANTED: Skein dyer, some knowledge of direct and vat dyeing on cotton and rayon yarns. Also in the market for several used Klauder Weldon or Giles skein dyeing machines. Write Box No. 506, American Dyestuff Reporter, 440 Fourth Ave., New York 16, N. Y.

WANTED: Dyer, experienced on rayon, cotton and worsted yarns, direct and vat dyes; located in large midwestern city; write full details Box No. 507, American Dyestuff Reporter, 440 Fourth Ave., New York, 16, N. Y.

WANTED: Man with chemical training to sell our products to the textile, leather and allied industries. To locate in Philadelphia and travel in Pennsylvania and surrounding states. Should be able to demonstrate and assist in the solving of dyeing, finishing and kindred problems. Apply only if qualified, stating age and draft status. Jacques Wolf & Co., Passaic, N. J.

UNUSUAL OPPORTUNITY to join sales department of prominent chemical manufacturer. Permanent postwar position on salary and profit sharing basis. Cotton man wanted for deep South. Hosiery man wanted for Pennsylvania. Write Box No. 508, American Dyestuff Reporter, 440 Fourth Ave., New York, 16, N. Y.

WANTED for a research laboratory a textile chemist with practical experience in printing; high educational background; familiar with permanent finishes and their components. Apply describing education, experience, references and salary expected to Box No. 509, American Dyestuff Reporter, 440 Fourth Ave., New York, 16, N. Y.

WANTED: Textile research chemist with experience in the production and application of textile finishes on rayons. Knowledge of resins desirable. Large rayon dyeing, finishing and printing plant. Location—New Jersey. State age, draft status, experience, references and salary desired. Write Box No. 510, American Dyestuff Reporter, 440 Fourth Ave., New York, 16, N. Y.

WANTED: Representative—with technical training to cover established New England territory on salary and expense basis in sales and service of colloidal chemicals, to textile print plants, paint, food and other industries. Permanent position. In applying give complete information and state salary expected. Our present employees know of this advertisement. Write Box No. 511, American Dyestuff Reporter, 440 Fourth Ave., New York, 16, N. Y.

WANTED: Laboratory assistant; some experience in application of dyes and finishes to textiles. Write Box No. 512, American Dyestuff Reporter, 440 Fourth Ave., New York, 16, N. Y.

WANTED: Textile chemist for laboratory research with large dyeing and printing company. Must have technical education and some practical experience. State qualifications fully and salary expected. Write Box No. 513, American Dyestuff Reporter, 440 Fourth Ave., New York, 16, N. Y.

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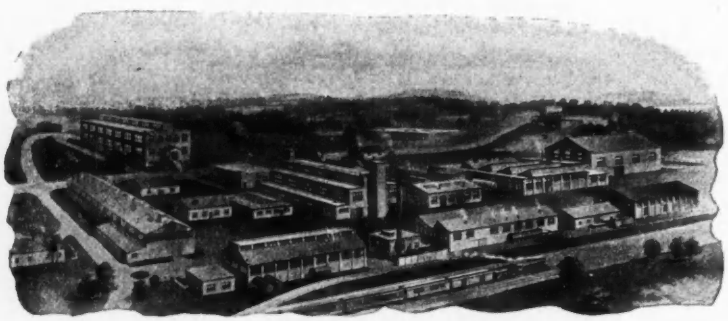

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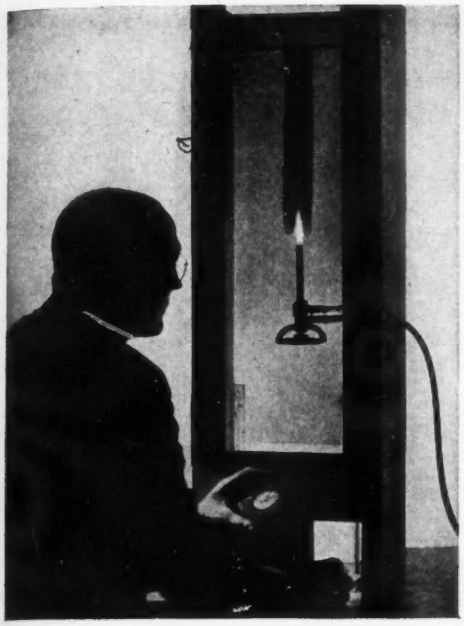
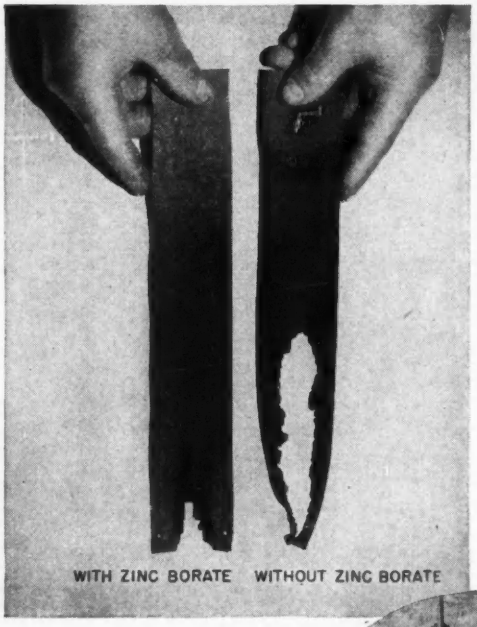




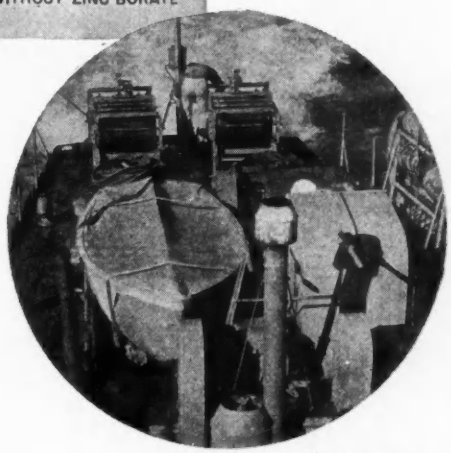
The results of a two minute flame test on treated and untreated duck strips (left) demonstrate how effectively Zinc Borate-3167 resists the flame and checks the afterglow, retarding the spread of flame to a minimum. A specimen of duck in the combustion chamber is shown at far left.

DUCK and DRILL COVERS made FIRE-RESISTANT with ZINC BORATE-3167

IN fire-resistant compositions of the weather-resistant type, ZINC BORATE-3167 is effective not only in damping the flame but also in depressing the afterglow. That is why Zinc Borate-3167 is used in treating cotton duck life boat and hatch coverings, and cotton drill life preserver coverings.

Zinc Borate is a white, very fine powder (99% through 325 Mesh Screen), containing less than 1% of water soluble impurities. It also possesses fungistatic properties, thus inhibiting the growth of mildew-producing fungus.

The Development Products Division of The New Jersey Zinc Company will gladly give you further information about the application of Zinc Borate-3167 in ducks and drills, as well as suggestions on its use in the treatment of other fabrics.



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The hazards of fire spread by life boat or life preserver covers is reduced materially when the duck or drill covering material is treated with a fire-resistant compound which includes Zinc Borate-3167.

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Indicated post-war uses for Zinc Borate-3167 include marine and industrial tarpaulins, work-clothes, aprons and gloves, awnings and canopies, welders' curtains, theatrical draperies and decorations, automobile upholstery, building materials and paints, etc., in all of which Zinc Borate-3167 will play an important part as a weather and mildew resisting fire-retardant.

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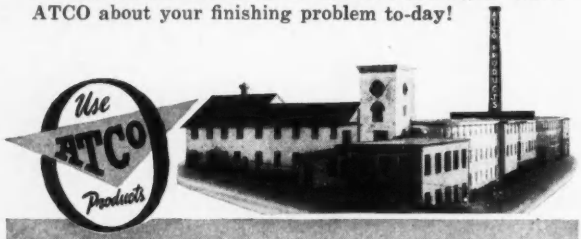

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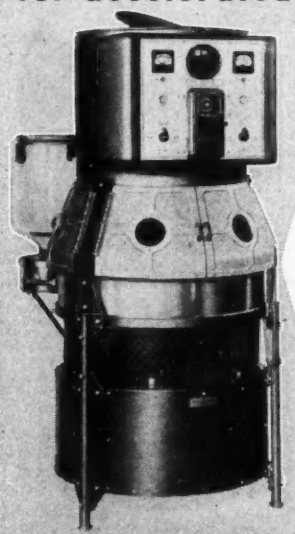

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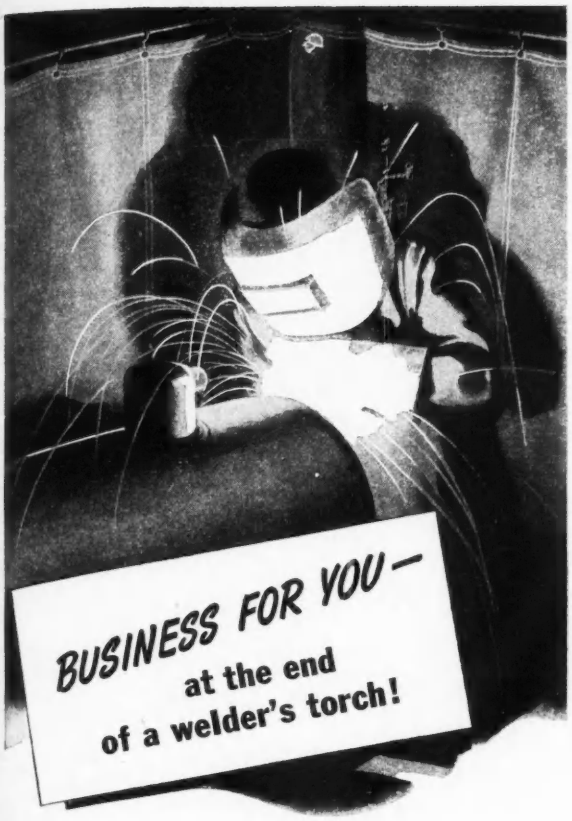

The screen curtaining around this welding operation *looks* like ordinary fabric. Yet, neither flying sparks nor direct contact with the fiery torch will cause it to spread flame! It's been treated with a Du Pont Fire Retardant—one of the most effective means of flameproofing fabrics—one of the most effective means of boosting *your* business!

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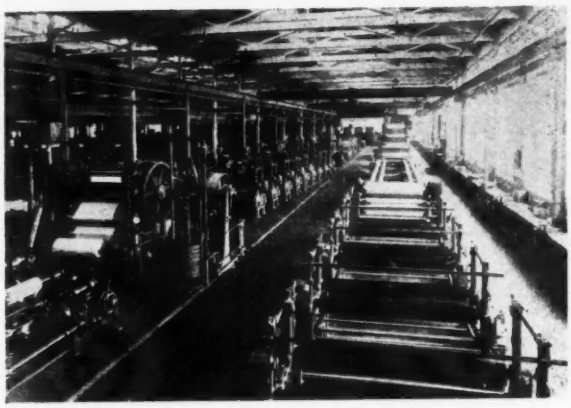

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• INDEX • TO ADVERTISERS

Althouse Chemical Co.	
Amalgamated Chemical Corp.	
American Aniline Products, Inc.	III
American Cyanamid & Chemical Corp.	Back Cover
American Dyewood Co.	
American Viscose Corp.	
Ansul Chemical Co.	
Aqua-Sec Corp.	
Aridye Corp.	
Arkansas Company, Inc.	IX
Arnold-Hoffman & Co., Inc.	
Atlantic Chemical Co.	XVIII
Atlas Electric Devices Co.	XVIII
Becco Sales Corp.	
Bick & Co., Inc.	
Burkart-Schier Chemical Co.	XXI
Butterworth & Sons Co., H. W.	XXII
Calco Chemical Division, American Cyanamid Co.	XV
Campbell & Co., Inc., John	
Carbide & Carbon Chemicals Corp.	
Carbic Color & Chemical Co., Inc.	XII
Ciba Company, Inc.	
Colgate-Palmolive-Peet Co.	
Commonwealth Color & Chemical Co.	XVI
Du Pont de Nemours & Co., Inc., E. I.	
Dyestuffs Division	Front Cover
Electrochemicals Dept.	X, XI
Graselli Chemicals Dept.	XIX
Emery Industries, Inc.	
Exact Weight Scale Co.	
Fancourt & Co., W. F.	
Gallowhur & Co., Inc.	
Geigy Company, Inc.	
General Dyestuff Corp.	VII
Glyco Products Co., Inc.	
Hart Products Corp.	
Hercules Powder Co.	
Naval Stores Department	
Hooker Electrochemical Co.	
Industrial Rayon Corp.	
Kali Manufacturing Co.	
Laurel Soap Mfg. Co., Inc.	
Leatex Chemical Co.	
Magna Manufacturing Co.	
Mathieson Alkali Works, Inc.	
National Aniline Division, Allied Chemical & Dye Corp.	XIV
National Carbon Co., Inc., Carbon Sales Division	
National Starch Products	IV
New Jersey Zinc Co.	XVII
Nyanza Color & Chemical Co.	XVI
Onyx Oil & Chemical Co.	V
Pabst Sales Co.	XX
Perkins & Son, B. F.	
Philadelphia Quartz Co.	
Procter & Gamble	
Quaker Chemical Products Corp.	VIII
Refined Products Corp.	
Rohm and Haas Co.	
Royce Chemical Co.	
Sandoz Chemical Works	
Scholler Bros., Inc.	Third Cover
Socony-Vacuum Oil Co., Inc.	
Solvay Sales Corp.	
Sonneborn Sons, L.	Second Cover
Smith, Drum & Co.	
Standard Brands, Inc.	
Stein, Hall & Co., Inc.	
Sylvania Industrial Corp.	VI
Tennessee Eastman Corp.	
Titanium Alloy Mfg. Co.	
Union Carbide & Carbon Corp.	
Van Vlaanderen Machine Co.	XIX
Virginia Smelting Co.	
Westvaco Chlorine Products Corp.	
Wallerstein Co., Inc.	XVIII
Warwick Chemical Co.	
Wolf & Co., Jacques	
Young Aniline Works	
Young Co., J. S.	
Zinsser & Co.	

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The invention of the copper roller, by Thomas Bell, in 1775, is generally thought of as the beginning of modern printing, but without Scheele's work this printing process could not have been put to practical use.

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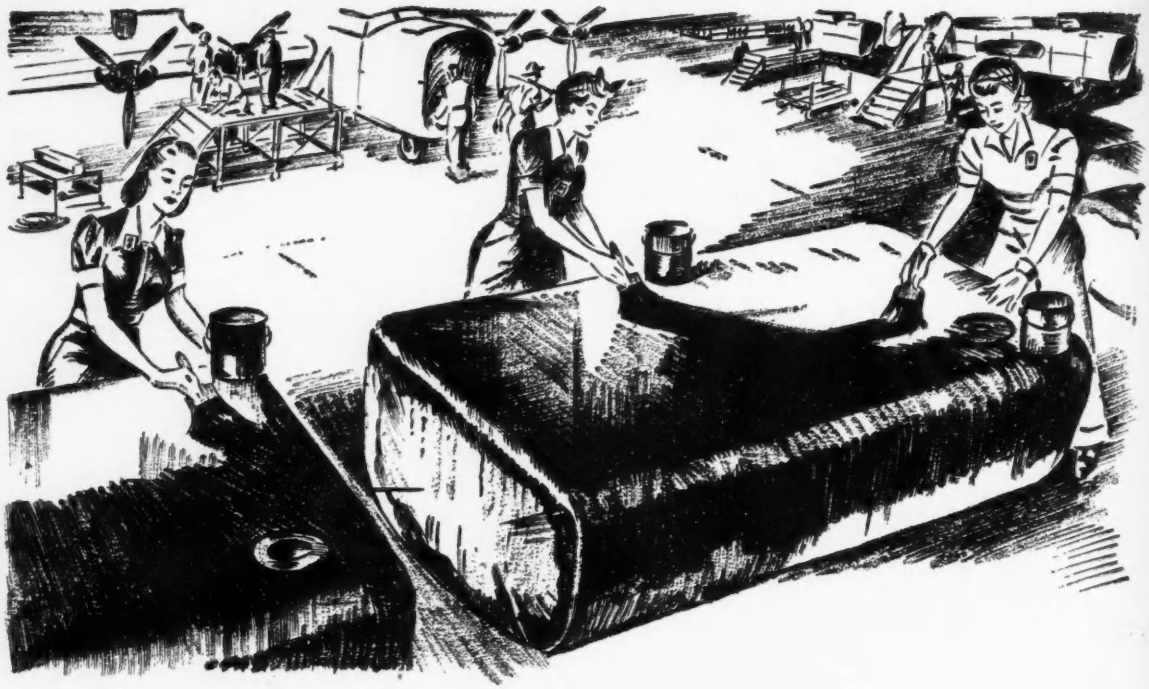

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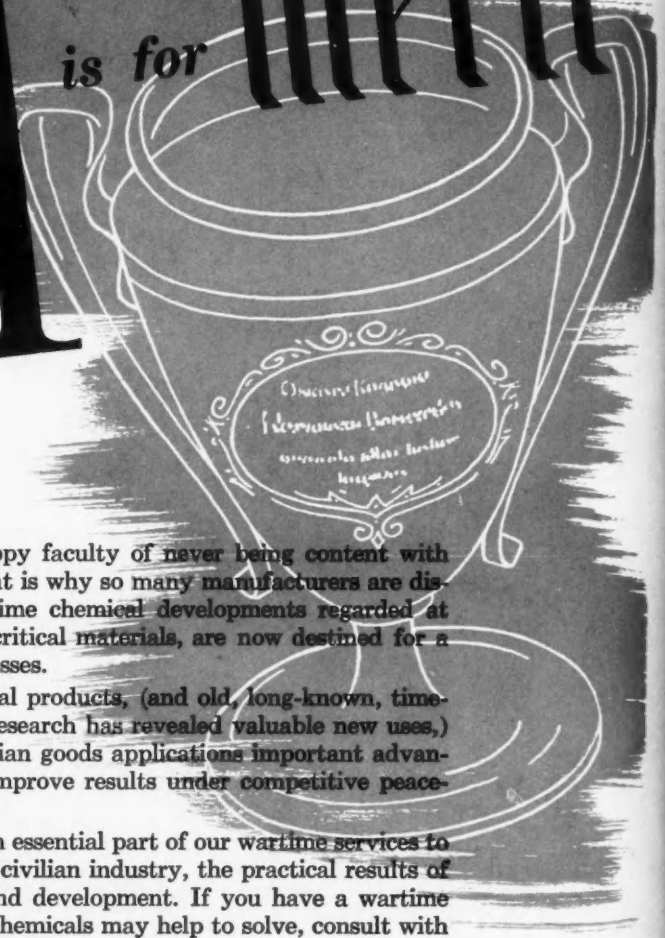

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